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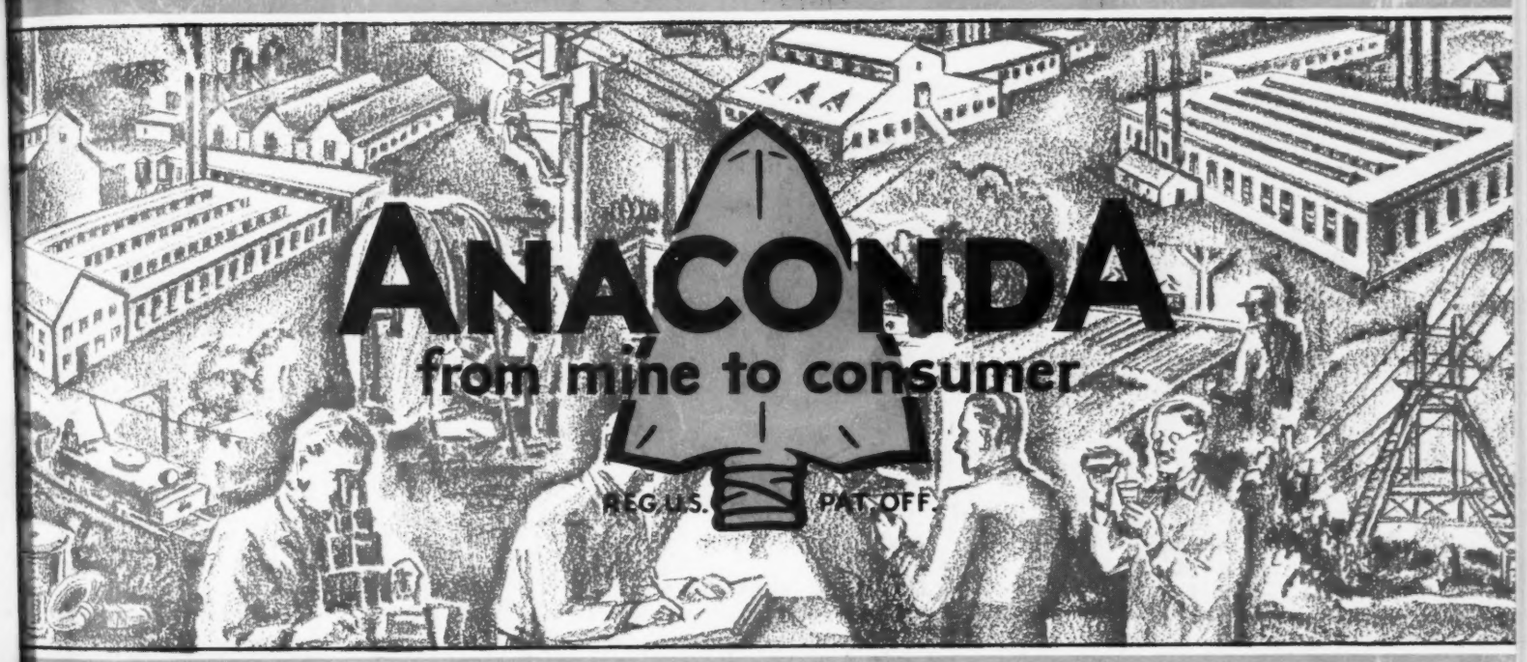

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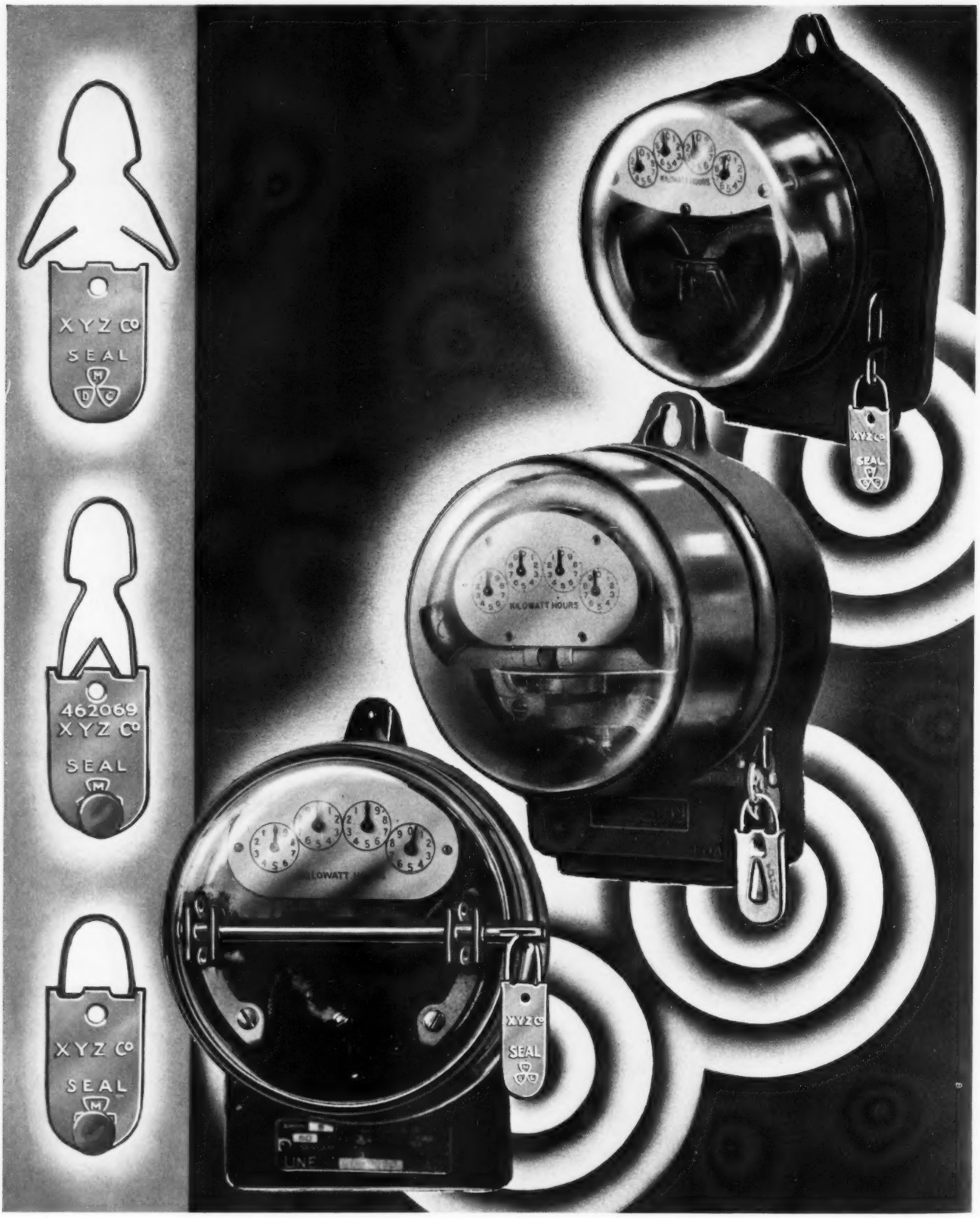

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A consolidation of Electrical World, Electrical Engineer and American Electrician

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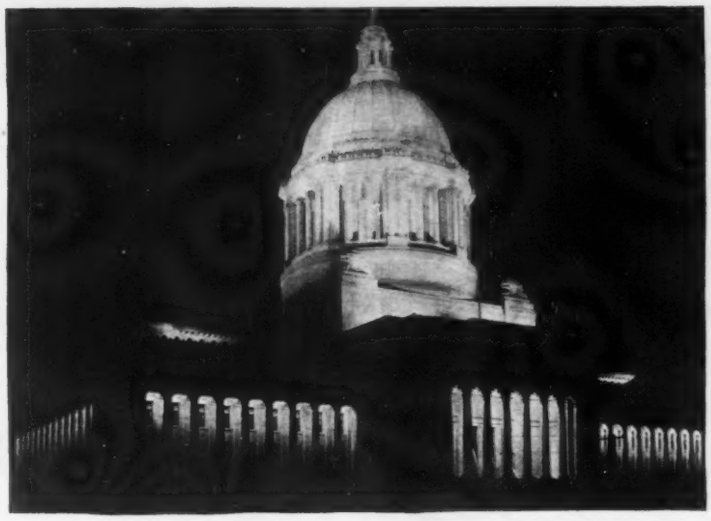

State Capitol
Olympia, Wash.

Keystone View

OCTOBER 24, 1931

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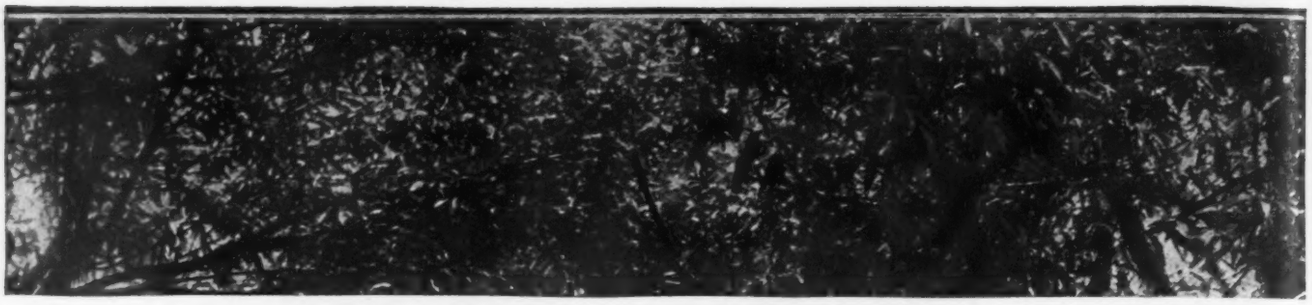

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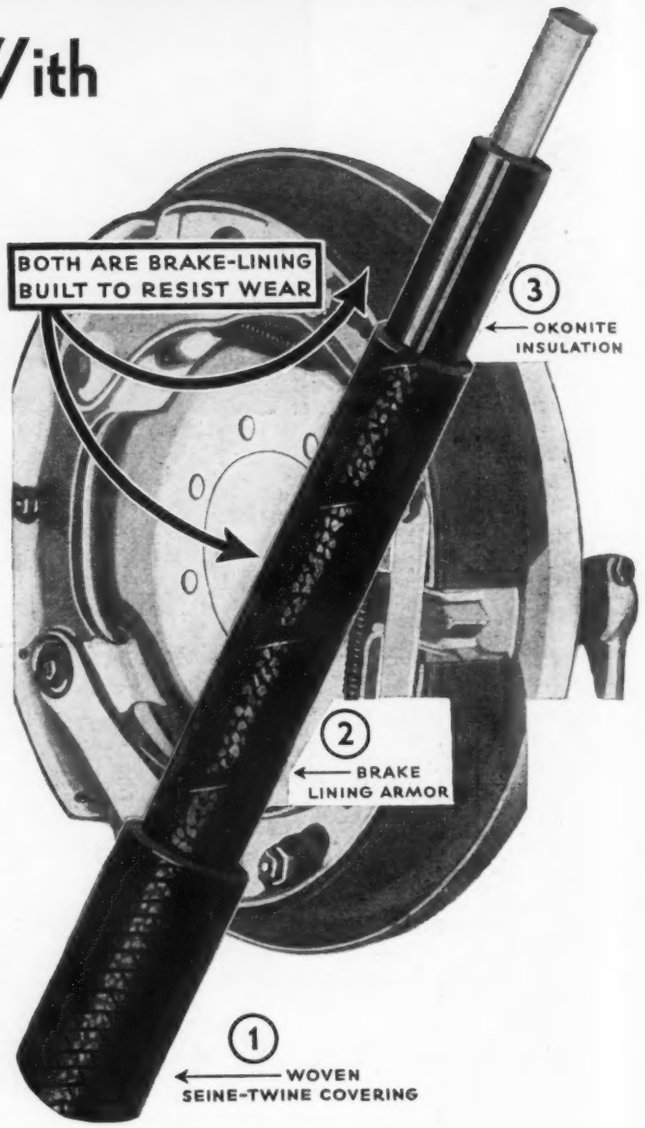

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ELECTRICAL WORLD

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for the Week Ending

October 24, 1931

EDISON

On Sunday, October 18, 1931, at 3:24 a.m., lacking but three days of the fifty-second anniversary of the lighting of his first incandescent lamp, Thomas Alva Edison lost his battle with the wasting forces that had cumulatively sapped his strength for many months.

In two days some twenty-five thousand people streamed through the library of the West Orange laboratory, where Mr. Edison had spent so many fruitful hours and where, with a fine appreciation of the fitness of things, the outworn body of one of humanity's greatest benefactors rested. Those who journeyed to West Orange included delegates from the Edison Pioneers and from the Association of Edison Illuminating Companies.

Leaders in every walk of life sought for words to express the keen sense of loss which an immensely enriched world felt on the passing of this man whose priceless gift of light and electric power was but one out of the abundance of his contributions to his fellow men.

"My message to you is to be courageous. I have lived a long time. I have seen history repeat itself again and again. I have seen many depressions in business. Always America has come out strong and more prosperous. Be as brave as your fathers were before you. Have faith — go forward."

[Mr. Edison's message to the National Electric Light Association, Atlantic City, N. J., June 11, 1931.]

"Progressives'" Committee on Public Utilities Makes Radical Report

LAST March there was held in Washington D. C., a so-called "progressive conference" under the chairmanship of Senator Norris of Nebraska which appointed a committee on public utilities headed by Donald R. Richberg of Chicago and including 23 other well-known persons interested in utility problems and representing more or less radical schools of thought concerning their proper solution. The membership includes state commissioners, editors, lawyers, college professors, utility accountants and specialists and out-and-out agitators for public ownership. This committee has just issued its report, which takes the position that "public control of all public business is essential to self-government" and draws the conclusion from the alleged failures of public regulation of public utilities that "we cannot give to private agencies monopolies of public business without building up a government for private profit and breaking down a government for the common good." The lesson of the regulatory period is stated to be that "public competition is the most effective form of regulation. The way to recapture public control of public business is to promote public operation of public business."

The report advocates the regulation of existing privately owned electrical utilities through a federal commission, co-ordinating its work with state regulation, "so as to preserve, so far as possible, the powers of local self-government without permitting corporations and their activities, which are beyond state authority, to relieve themselves of effective public control." But "further developments in this field should be confined, wherever the alternative is available, to direct public control."

It is recommended that such public enterprises "should be self-supporting and should be controlled by public corporations as free from immediate political pressure as the privately owned public utilities, but also incapable of exerting the political pressure now being exerted by such corporations."

A "government railway system supplementary to and competitive with the privately owned railroads" and the creation of a "federal commission on communications" to regulate telephone, telegraph and radio services are recommended.

The report finally advocates the fixing of definite legal limits on private profits out of public utility business, restricting individual gain to "a generous compensation for actual personal service and a moderate compensation for actual investment," on the ground that "the hope of speculative gain is unalterably hostile to public business and draws into public business persons poorly qualified for positions of public trust."

It seemed apparent to the committee, its chairman asserts, that, in order to destroy "a subversive private control" of government and "the corruption of public opinion" by those having a huge financial interest in the "private control of public offices," vigorous measures are necessary. The chairman stated that effective restraint upon these private interests will, of course, be denounced as "socialism" or "bolshevism," "according to the tactics of the public utilities which have been exposed in the Federal Trade Commission investigation." But the program reported by the committee is, according to Mr. Richberg's definition, the product, not of socialistic theory, but of a faith in "co-operative individualism." Individual freedom can only be preserved, according to progressive doctrine as he interprets it, through "opposing equally the tyranny of industrial dictators who would control the state and of political dictators who would control all industry."

Besides Mr. Richberg, the members of the committee on public utilities of the Progressive Conference are: Paul U. Kellogg, Amos Pinchot, W. E. Mosher, Judson King, James C. Bonbright, Walter S. Bemis, Theodore Kronshage, Jr., Carl D. Thompson, Mrs. Ann Dennis Bursch, Willis J. Spauling, Kenneth Harlan, E. W. Morehouse, J. D. Ross, Morris L. Cooke, E. N. Nockels, John M. Baer, David E. Lilienthal, Lloyd E. Bemis, Henry T. Hunt, Charles E. Merriam, Newton Jenkins, Martin G. Glaeser and Stephen Raushenbush.

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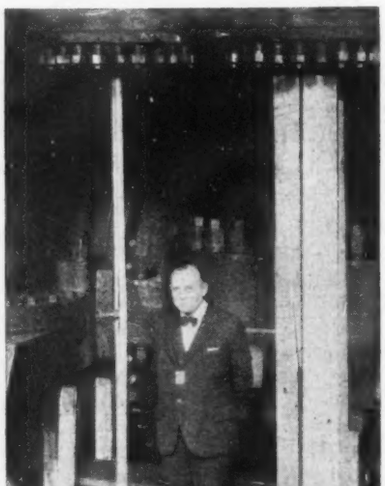
CARLISLE AT SCHENECTADY



Floyd L. Carlisle, chairman of the board of the Niagara-Hudson Power Corporation, recently paid a visit to the Schenectady plant of the General Electric Company, viewing the second 160,000-kw. steam turbo-generator being assembled for test before shipment to the Brooklyn Edison Company.

▼

California Commissioner Attacks Federal Courts

DECLARING THAT state regulation of public utilities in California, as in other states, is facing "actual and potential danger" through "the present intolerable interference by lower federal courts," Clyde L. Seavey, president of the California Railroad Commission, on Wednesday of this week urged upon the National Association of Railroad and Utilities Commissioners, in convention at Richmond, Va., the importance, as he saw it, of congressional legislation to correct a situation which threatens "to destroy the effectiveness of regulatory action" and "to eliminate state control of state rates, effective state control of service and safety, and the maintenance of proper relationship between various groups and communities."

"If control of rates breaks down," Mr. Seavey told the convention, "the whole fabric breaks down. This form of regulation is a new venture. It has accomplished much as an impulsive movement. But to pass the final test in the minds of the people as well as the courts it must be clothed with some dignity and grounded on permanent authoritative substance."

The present situation the speaker declared to be an outgrowth of a radically changed interpretation by federal courts of the constitutional amendment forbidding confiscation of property without due process of law. This provision, he states, had been interpreted to vest control in federal courts over rates as fixed by state regulatory bodies. He went on to say:

It is safe to say that in practically none, if any, of the cases in which there have been permanent injunctive orders issued by the federal courts would actual confiscation have followed the commission findings. This is stated not only from general

knowledge of the facts but from specific knowledge of the experience in California. A study of the court opinions indicates beyond reasonable doubt that in practically every major rate case in the last seventeen years in that state the findings of the commission could not have withstood the test imposed by the federal tribunals. And yet we find the affected utilities able adequately to finance, operating at relatively low rates and giving good service. The same thing undoubtedly may be said of other states. . . .

The Supreme Court looks upon commission rate making as a legislative rather than a judicial act, and it construes due process of law to require a complete judicial review of such state commission action when confiscation of property is claimed. While we may believe this is neither good law nor equitable legal procedure, still it stands as the law unless some way be devised to overcome it. It is worthy of trial to see if Congress by statute may not effectively moderate such court definition.

▼

Bagnell Plant Goes Into Commercial Operation

COMMERCIAL OPERATION of the thirty-million-dollar hydro-electric plant of the Union Electric Light & Power Company of St. Louis, on the Osage River near Bagnell, Mo., began on October 19, Louis H. Egan, president of the company, has just announced. The plant will develop 268,000 hp., and energy is transmitted to St. Louis and to St. Francois County to serve the mines and smelters of the St. Joseph Lead Company. The Bagnell Dam and power plant were constructed by the Stone & Webster Engineering Corporation.

Three small steam plants belonging to the St. Louis company—in Venice and Alton, Ill., and River Mines, Mo.—are to be closed temporarily, but will be held in readiness for emergency use. The closing of the three plants will save 100,000 tons of coal a year.

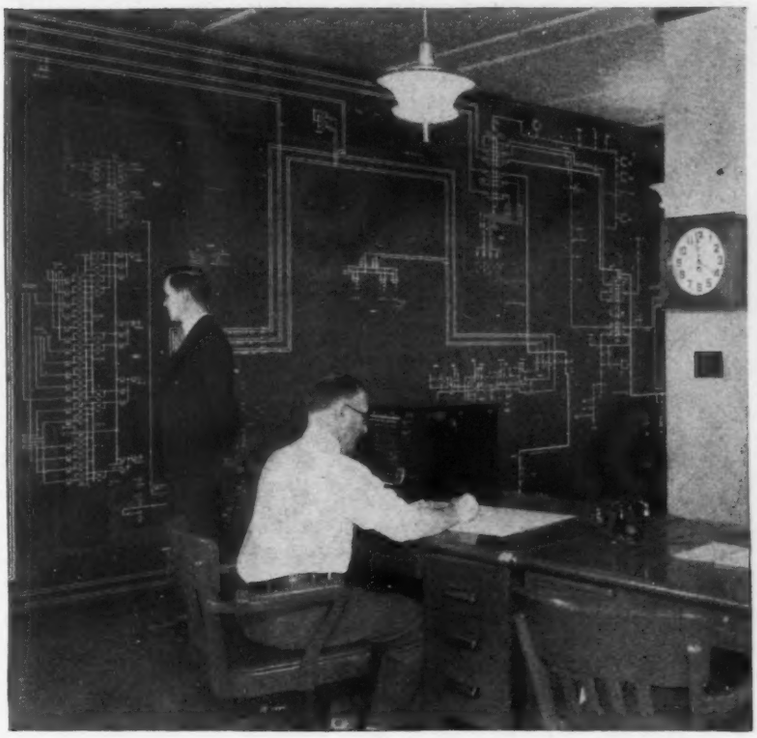
▼

New Generating Station Planned for Washington

OWING TO STEADY INCREASE in power consumption in its territory, the Potomac Electric Power Company of Washington, D. C., is considering plans for the construction of a new generating plant. Officials of the company have decided that it would not be practicable to install any additional units at the Benning plant, where the output of power has gradually been increased to a maximum of 208,000 kw. A 30,000-kw. unit has just been added to this plant. It is believed that any further increase in rating would require more water for condensing purposes than is readily available at the location. The company has therefore tentatively selected a site for a new plant at Buzzard Point in southwest Washington near the confluence of the Anacostia and Potomac Rivers. It is understood that the new plant will have an ultimate capacity of 200,000 kw. with an initial installation of between 35,000 kw. and 50,000 kw.

In addition to supplying adequate facilities for future growth, the Buzzard Point location will make it possible for coal to be obtained by barge. If engineers of the company become convinced that the present low prices of fuel oil will remain fairly constant, it may be decided to utilize oil instead of coal for the production of power. Fuel cannot be transported by barge to the Benning plant because the river becomes shallow at that point.

MOSAIC SYSTEM MAP SHOWS EVERY PHYSICAL CHANGE



Thousands of mosaics, each 1 inch square, make up a removable face-system diagram board in the Buffalo office of the Niagara-Hudson Power System load supervisor, eliminating rolls of charts and blueprints. Each mosaic represents a section of power line or a piece of power equipment. Semaphores and signals are worked from a telephone dial

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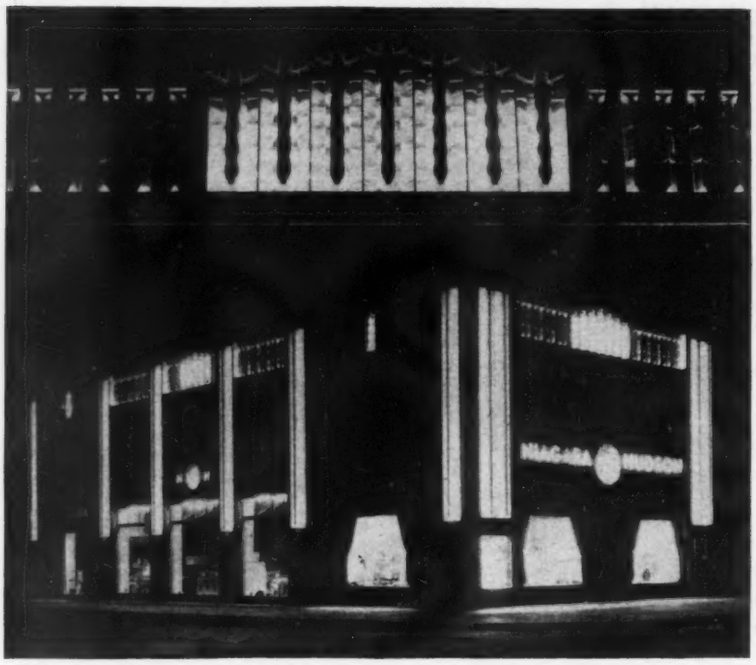
Georgia Commission Evens Rates in Crisp County

AFTER MORE THAN A YEAR of public hearings, executive deliberations and litigation, the Georgia Public Service Commission has decided not to compel the Georgia Power Company to reduce its rates throughout the state to the level it has set in Cordele and its surrounding territory.

The history of the case dates back to August, 1930, when the power plant owned by Crisp County, in which Cordele is situated, began operations and fixed a scale of rates about 15 per cent lower than rates of the Georgia Power Company in that section. The power company countered with a 50 per cent discount, and on August 22 last year the Public Service Commission issued an order directing the Georgia Power Company to show cause why its rates all over the state should not be reduced to the same level. The company disputed the commission's authority, but the Georgia Supreme Court upheld it.

The commission now holds that the situation in Cordele is unique, and that lower rates to meet competition from the publicly owned system do not constitute unjust discrimination within the meaning of the law against customers served by the company in its other territories. On this ground the proposed order to compel the company to make its rates uniform has been dismissed, but the company has been ordered to increase its Cordele rates to the level of those being charged by the Crisp County plant.

STAGGERED REFLECTION YIELDS UNIFORM SHADOWS



ILLUMINATING engineers of the Buffalo, Niagara & Eastern Power Corporation have discovered that staggered reflection can be made to yield a uniformity of shadow that is most effective. For a new design across the front and side of the Olean (N. Y.) service office and store they inclosed nine 60-watt evenly spaced lamps within a unit. These nine lamps cast three different degrees of light or shadow, first the full light from the lamp, second the shadow cast by the lamp cap, third the deeper shadow due to the spaces between the nine lamps. Inclosing nine more 60-watt, evenly spaced lamps within a similar unit, they set up this second unit one lamp higher than the first, thus causing the two sets of shadows to interlock.

Across the front and down one side of the Olean structure two such pyramids have been installed, each comprising seven pyramided units and each unit housing nine 60-watt lamps. At each side of the two sets of pyramided units there are five vertical pillars of light, each pillar illuminated by one 150-watt floodlight. In addition there are ten pilasters, side and front, each lighted by 30 60-watt lamps. The total exterior lighting load is 36.3 kw.

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H. L. Doherty and the A. E. C. Employment Plan

TO ANSWER INQUIRIES concerning the conditional offer of Henry L. Doherty to donate $500,000 to finance an approved engineering plan to combat unemployment and business depression—this offer being in response to an inaccurate report of a speech by President Roy V. Wright of the American Society of Mechanical Engineers before the recent Kansas City meeting of that society (ELECTRICAL WORLD, September 19, page 488)—the society referred to has authorized a statement to the following effect:

The American Engineering Council plan referred to by President Wright, which has received the indorsement of a large number of prominent industrialists and engineers, was presented to Mr. Doherty. However, Mr. Doherty's original telegram offering the $500,000 included certain specifications and left him and men of his selection the decision as to whether the plan met these specifications. Mr. Doherty has concluded that it does not. The American Engineering Council is proceeding with the presentation of its plan to other groups and is greatly encouraged with the progress being made.

▼

Garsaud on Power Plants Versus Reclamation

AFTER VISITING 30 water-power projects in the West, Colonel Marcel Garsaud of the Federal Power Commission has returned to Washington and declares himself impressed particularly with the need of careful study to determine in certain instances whether reclamation or power constitutes the more beneficial use of water to the public. He is of the opinion that mistakes in awarding water to reclamation projects of doubtful feasibility when it could have been used to greater public advantage for generating power can be avoided by insisting upon thoroughgoing and impartial engineering and economic studies. In determining the more beneficial use he thinks the public interest as a whole should be considered. Unless the feasibility of a reclamation project can be clearly established in advance, he thinks water should not be taken away from a sound water-power development. By developing a feasible power project loss of public funds in a doubtful reclamation venture might be avoided, in the opinion of Mr. Garsaud.

▼

South Carolina Strong for Rural Electrification

GOVERNOR BLACKWOOD of South Carolina has declared that he will present the cause of rural electrification to the 1932 Legislature. Speaking at a public hearing of the state commission now investigating rural electrification, the Governor said he foresaw "relief from the drudgery and hardship borne by farm wives," "conversion of vast uninhabited stretches of the state into attractive regions" and the passing of small villages "in favor of distributed community advantages over sparsely settled areas of the country."

Two plans have been outlined by Dr. John Bauer, the advisory technician of the power commission—one to have the utility companies "handle the whole business themselves" and the other for the formation of associations in rural districts which would erect rural lines to tap the high-voltage wires of the power companies.

It was pointed out that advances in rural electrification have been made near Columbia and elsewhere in the central part of the state.

▼

Public Utility Men Aid Chicago Safety Congress

HOT-LINE TOOLS and grounding of electrical circuits were the only specifically technical subjects of interest to electrical men treated in the Public Utility Section sessions of the National Safety Congress held in Chicago from Monday to Friday of last week.

The largest amount of time in the six sessions of the section was given over to papers and discussions on the promotion of safety programs and the fixing of responsibility for them. In the latter regard the consensus of opinion pointed to the foreman on the job as the person on whose shoulders the burden of responsibility lay.

"Selling the Safety Program," by Joseph W. Hicks of the Byllesby Engineering & Management Corporation,

stressed the point that no program can be effective until and unless it has wholeheartedly been accepted by those concerned in it. "Community Aspects of Safety Work," by George Opp of the Detroit Edison Company, brought out the fact that the effect of such work in any operating organization does not end in the organization but is felt very definitely in the community at large.

Probably because it is a rapidly growing development and therefore subject to the shifts and changes inherent in things at their beginning, the paper on hot-line tools by James Hill, Jr., of the Southwestern Gas & Electric Company provoked rather long discussion in which great diversity of opinion and practices was exhibited. There is no standardization of practice with respect to voltages on which hot-line tools should be used nor on such details as to whether or not men using hot-line tools should also wear rubber gloves. The paper on safety grounding by Wills MacLachlan of Toronto emphasized from the standpoint of safety the same adequacy in grounding that the electrical engineer is seeking for the proper operation of electrical systems.

▼

Mississippi Utilities Run Wild, Governor Bilbo Says

POWER COMPANIES in Mississippi are "running wild" without regulation of any kind, declared Governor Bilbo in a message delivered last week to the Legislature, now in special session. He asked the lawmakers to memorialize the Tax Commission to assess the companies in conformity with their valuations. The Governor recommended legislation looking to supervision, regulation and control of rates, facilities, plants, practices, rules, operation and service, and finance and securities of companies.

"The greatest oppression from which the people are suffering today—an oppression that is wholesale throughout the state, an oppression that should not be tolerated by the patriotic and honest representatives of the people one moment longer," said Governor Bilbo, "is the extraction from the citizens of Mississippi of between $10,000,000 and $12,000,000 annually by the power companies that are permitted without regulation or control of any sort or kind to make all sorts of trades and combinations, float all sorts of securities, pay fabulous prices for properties, issue bonds galore, spend money without limit and in turn fix rates to take care of the whole dazzling program."

To carry out his regulatory program, the first recommendation of Governor Bilbo was a law compelling every member of the Legislature and each member of the state commission to file with the Secretary of State a statement under oath showing, if any, their connection or employment by any public service corporation.

▼

More About Unique Plant Designed for Schenectady

AS ALREADY REPORTED in the ELECTRICAL WORLD, the first comprehensive attempt to co-ordinate the steam and electric requirements of a manufacturer with the production and sale of power on the part of a utility is being made at Schenectady by the General Electric Company. A coming plant, combining mercury-vapor and steam boilers, will be operated by the New York Power & Light Corporation. This company will sell power and steam to the General Electric Company, the power being obtained from the utility system and the steam from this plant, whereas the power from this plant will flow into the power company's system regardless of General Electric power demands. The main apparatus will be installed outdoors to reduce building and structure cost. Accessory equipment, such as pumps, fuel pulverizers, weighing and feeding equipment, switchboards, controls, drips and drains, will be installed in the low building structure.

The manufacturing requirements, according to the company, are 600,000 lb. of steam per hour at 200 lb. pressure. Half of this will be produced by the mercury boiler and half by a steam boiler. As a byproduct there will be 26,000 kw. of electricity, 20,000 kw. of which will be produced by the mercury turbine. There will be no condensing turbines in this plant, a 6,000-kw. steam turbine simply reducing the steam pressure from 400 lb. to 200 lb. The steam condensers in a sense are the process steam and heating coils throughout the General Electric factory. The result is that this power will be made at a thermal efficiency of the order of 85 per cent.

Simultaneously with the building of the Schenectady plant a second installation is to be made in the Kearny plant of the Public Service Company of New Jersey, but the Schenectady plant will differ in that the mercury turbine will be at a low level and the mercury will be pumped from that level up into the boiler just as water is supplied to a steam boiler.

▼

Northwest Inspectors Meet at Salem, Ore.

INSPECTORS AND CONTRACTORS from the Pacific Northwest States heard interesting portrayals of major code problems and discussed committee reports recommending changes in the National Electrical Code at the sixth annual convention of the Northwestern Section, International Association of Electrical

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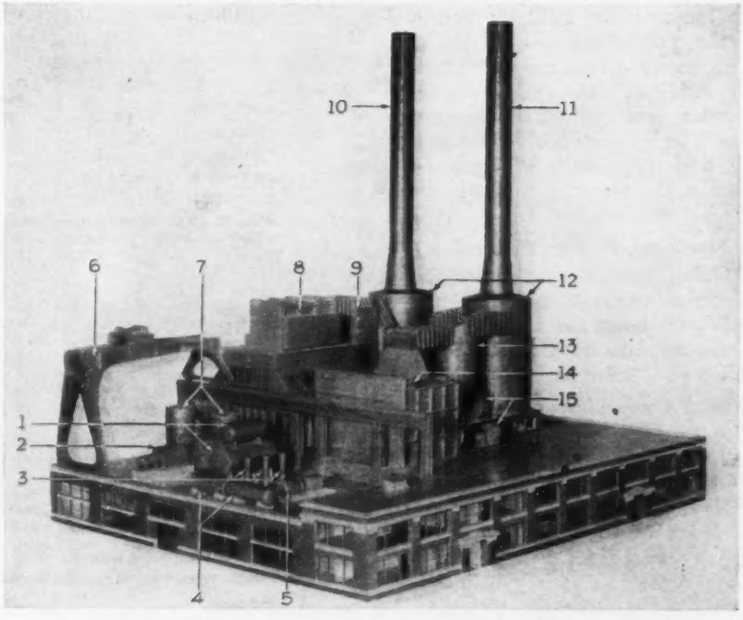
MODEL OF G.E. MERCURY-PROCESS POWER PLANT



1. Deaërator. 2. Mercury turbo-generator. 3. Feed-water heaters. 4. Evaporators. 5. Steam turbo-generator. 6. Gantry crane. 7. Condenser boilers. 8. Mercury boiler. 9. Air preheater. 10. Mercury boiler stack. 11. Steam boiler stack. 12. Cylinders containing induced-draft fans and serving as coal bunkers. 13. Air preheater. 14. Steam boiler. 15. Forced-draft blowers.

Inspectors, at Salem, Ore., October 5-7. Arthur L. Abbott, N.E.M.A., New York, presented the new standard of the Association of Electragists to insure adequacy in house wiring, while the "red seal" plan was explained by V. W. Hartley, San Francisco. L. W. Going, chief electrical inspector of Portland, insisted that "inadequate wiring is destined to become unsafe and that adequacy therefore is a code responsibility."

A tendency to give more consideration to the interests of water companies and waterworks departments in making rules on grounding was noted in the discussion of a committee report presented by E. B. Morrison of Portland. Where the water piping systems have cement joints or sections of wooden pipe the companies are going to artificial grounds. Extension of permission to use metallic tubing in various locations was advocated in the report of three different committees. In a discussion of the uniform ordinance, led by W. J. Canada, New York, the necessity for control by law of the number and quality of manufactured articles used in wiring was brought out.

J. A. Casey, electrical inspector, Walla Walla, was chosen president of the association for the coming year, and Wenatchee, Wash., was chosen as the place of the 1932 meeting in September.

▼

Scattered Happenings in the Electrical Sphere

UNITED STATES

Utilities of West Virginia Help State

Advance payment of one-half of their taxes due January 20, 1932, is being made by the public utilities of West Virginia in response to a request from the State Auditor, who says public funds are at a low ebb. The amount advanced will be between $5,000,000 and $7,000,000, and the utilities' "magnanimous attitude" is warmly praised by the state's financial authorities.

Oklahoma Municipal Project Defeated

Pryor, Okla., served by the Public Service Company of Oklahoma, defeated a proposed bond issue for a municipal light and power plant on October 8 by 208 to 135.

Alliance (Ohio) Companies to Be Sold

Authority to sell the property of the Suburban Light & Power Company of Alliance, Ohio, including its franchises, at public auction, has been granted to Joseph G. Fogg of Cleveland, receiver of the company, by a federal judge. The sale was authorized to satisfy a judgment of $2,749,894 recently awarded the New York Trust Company. The Suburban Light & Power Company controlled the Suburban Power Company and the General Light & Power Company, both of Alliance. Sale of the last named for not less than $210,000 has been ordered by another federal court in Cleveland.

Edison Sault Company Expands

An expansion program to serve the major portion of the eastern Upper Peninsula of Michigan, and involving the expenditure of $700,000, is announced by Thomas Chandler, president of the Edison Sault Electric Company, a subsidiary of the American States Public Service Company. The program includes the acquisition of electric power and light properties at Mackinac Island, electric properties at St. Ignace and a joint interest in the Manistique Light & Power Company. It also includes virtually doubling the capacity of the company's hydro-electric power plant at the Sault and the construction of approximately 140 miles of 66,000-volt transmission lines from the Sault to St. Ignace and Manistique, which will link all of the company's plants.

Cables to Span the Susquehanna

Wire-stringing crews of the Pennsylvania Water & Power Company have begun to string transmission lines from the Safe Harbor hydro-electric development across the Susquehanna River. Crossing two railroads and a mile stretch of river, each cable will comprise two 3,000-ft. spans between a tower on an island near the middle of the river and those on the 300-ft. hills on either side. In all, ten cables are to cross the river.

Tide Water Company Adds Two Plants

By a vote of 341 to 4 citizens of Beaufort, N. C., decided to sell the municipal light and water plant for $210,000 to the Tide Water Power Company of Wilmington, N. C., which had previously acquired similar properties in Morehead City, N. C.

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Coming Meetings

National Electric Lighting Association—Accounting National Section committee meetings, Palmer House, Chicago, Oct. 26 and 27. A. J. Marshall, 420 Lexington Ave., New York.

International Association of Municipal Electricians—Jacksonville, Fla., Oct. 27-30. W. H. Harth, Columbia, S. C.

Great Lakes Division, N.E.L.A.—Engineering Section, Purdue University, Lafayette, Ind. Nov. 4-6. T. C. Polk, 20 N. Polk, 20 N. Wacker Drive, Chicago.

National Electrical Wholesalers' Association—Starrett's Netherland Plaza, Cincinnati, Nov. 9-13. E. Donald Tolles, 165 Broadway, New York.

Wisconsin Utilities Association—Electric Section, Hotel Pfister, Milwaukee, Nov. 12-13. J. N. Cadby, 135 W. Wells St., Milwaukee.

North Central Electric Association—Accounting Section, St. Paul Hotel, St. Paul, Nov. 13 and 14. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

International Conference on Bituminous Coal—Pittsburgh, Nov. 16-21. T. R. Alexander, Carnegie Institute of Technology, Pittsburgh.

Turlock Irrigation District Buys Plants

Directors of the Turlock Irrigation District in California have signed a contract to purchase properties of the Sierra & San Francisco Power Company for $170,000 to be paid for in electrical energy generated at the district's power plants at the Don Pedro and La Grange dams. The purchase means the withdrawal from the Turlock area, in so far as electricity is concerned, of the Pacific Gas & Electric Company, which held under lease the plants just sold.

Fairfield, Iowa, Rejects Municipal Plant

Voters of Fairfield, Iowa, have defeated a measure providing for a municipal electric light plant, by 1,029 to 851. The Iowa Electric Company, Cedar Rapids, will continue to serve.

Rock Island (Wash.) Transmission Line

The Puget Sound Power & Light Company has completed its power transmission line from the Rock Island power development of the company near Wenatchee to Skykomish, Wash., at a cost of approximately $900,000. From Skykomish west the power will be carried over an existing line.

Rates in Northeast California

At an election held recently in Lassen County, in the northeastern part of California, the voters approved by five to one the organization of the Lassen Municipal Utility District, to include Susanville, Halltown and Milwood. The movement had its inception in a campaign for lower electrical rates. Five directors were elected, all sponsored by the citizens' committee.

New Merced-San Joaquin Agreement

Approval by the California Railroad Commission of an agreement between the Merced Irrigation District and the San Joaquin Light & Power Corporation whereby the latter company agrees to furnish the necessary power for the maintenance of the irrigation district's operations, accepting as payment therefor a credit on power to be furnished the power company during 1932 from the irrigation district's plant at Exchequer Dam, has been asked.

Rates Down Again in Hamilton, Ohio

A fourth reduction in residential electric rates for Hamilton, Ohio, is announced by the municipal light plant, the total saving being put at $220,000. The new rate has a top step of 5½ cents per kilowatt-hour.

Pullman, Wash., to Vote on Ownership

An election has been set for December 8 by the City Council of Pullman, Wash., on the proposal to condemn and take over the distribution system of the Washington Water Power Company. Frank T. Post, president of the company, is calling attention to numerous alleged errors in the figures of the Tacoma lawyer whose report was used as a basis for the City Council's action.

Commission Denies Atlanta's Plea

The Georgia Public Service Commission has denied the petition from the city of Atlanta asking it to order the Georgia Power Company to show cause why its electric rates should not be reduced, on the ground that sufficient reason for such a request had not been shown.

Regional Rate in Indiana Up Again

Establishment of uniform and lower rates for electricity in 76 cities and towns in southern Indiana is again proposed by the Public Service Company of Indiana in a petition filed with the state commission. Company officials estimated that the proposed schedules would save about $370,000 annually for consumers. The proposed schedule for residential customers provides a service charge of 70 cents monthly plus 6 cents a kilowatt-hour for the first 30 kw.-hr. and 3 cents for any excess. Hitherto the commission has disapproved the institution of such regional rates.

CANADA

Middle West Utilities in Canada

A recent report states that upward of $17,000,000 is invested directly or indirectly in Canada by the Middle West Utilities Company of Canada, Ltd., Canadian operating division of Middle West Utilities Company. The group of controlled companies includes the Great Lakes Power Company, Algoma District Power Company and International Transit Company in Ontario; the National Utilities Corporation, Winnipeg Heating Company and Northern Public Service Corporation in Manitoba, as well as minority interests in other enterprises, including the Winnipeg Electrc Company. Directly owned Canadian subsidiaries serve 23 communities in the two provinces.

ABROAD

Progress of Electricity in Palestine

The Jerusalem Electric & Public Service Corporation has now 22½ miles of overhead lines and 21½ miles of underground cables. The number of consumers is 3,300, and further applications are being received in steady volume. Plant capacity has been increased and extensions made. Street lighting in both Jerusalem and Bethlehem is satisfactory.

Electric Street Lighting in Britain

According to a paper read at the International Illumination Congress by W. J. Jeffery of London, 70 per cent of the high streets and "broadways" in the metropolitan area of London are now entirely lighted by electricity. Of the total number of street-lighting standards in Great Britain 40 per cent are now electric, and since 1921 the total consumption of electricity for street lighting has increased by 163 per cent.

Saskatchewan Project Will Cost About $15,000,000

SASKATCHEWAN'S PROJECTED hydro-electric power scheme, involving development of the Saskatchewan River as the source of supply at a point about 45 miles east of Prince Albert and erection of transmission lines to the four largest cities in the province, will cost initially $15,000,000 and an additional $3,000,000 a few years later. These are the approximate costs of a provincial hydro scheme as outlined in a report by Prof. H. G. Acres of Toronto to the Saskatchewan Power Commission. The report indicates that sufficient power can be generated at the Horse Shoe Bend site on the Saskatchewan to take care of the maximum requirements of the cities of Regina, Saskatoon, Moose Jaw and Prince Albert for a number of years before it would be necessary to resort to steam for supplemental power during the periods of maximum demand.

Foundation conditions are reported as reasonably good, and a dam could be erected to give a head of 125 ft. of water on the turbines. The site would supply 43,200 hp. of continuous power throughout the year, or at a 50 per cent load factor would provide 86,400 hp. of salable power. Initial construction provides for the installation of two generating units and the erection of approximately 400 miles of high-tension transmission lines to serve the four principal cities. The ultimate installation would include four generating units.

Provision is made for the construction at the outset of a transmission line direct from the source of power to Regina with an extension to Moose Jaw, and a second line would extend from the power site to Prince Albert and from there to Saskatoon. Eventually the gap between Saskatoon and Moose Jaw would be bridged by another line, providing a two-way circuit for all four cities. The initial costs of the scheme include approximately $11,000,000 for the power development and $4,000,000 for the transmission lines.

Saskatchewan at present has only one hydro-electric development, that of the Churchill River Power Company at Island Falls on the Churchill River, developing 42,000 hp. for the mines and smelter at Flin Flon.

Canadian Utilities, Ltd., which recently purchased the municipal power plant at Prince Albert, Saskatchewan, for $750,000, has applied to the Saskatchewan Power Commission for permission to build a transmission line, costing $150,000 to connect Prince Albert with four towns, in each of which the company has acquired the local power plant and distribution system.

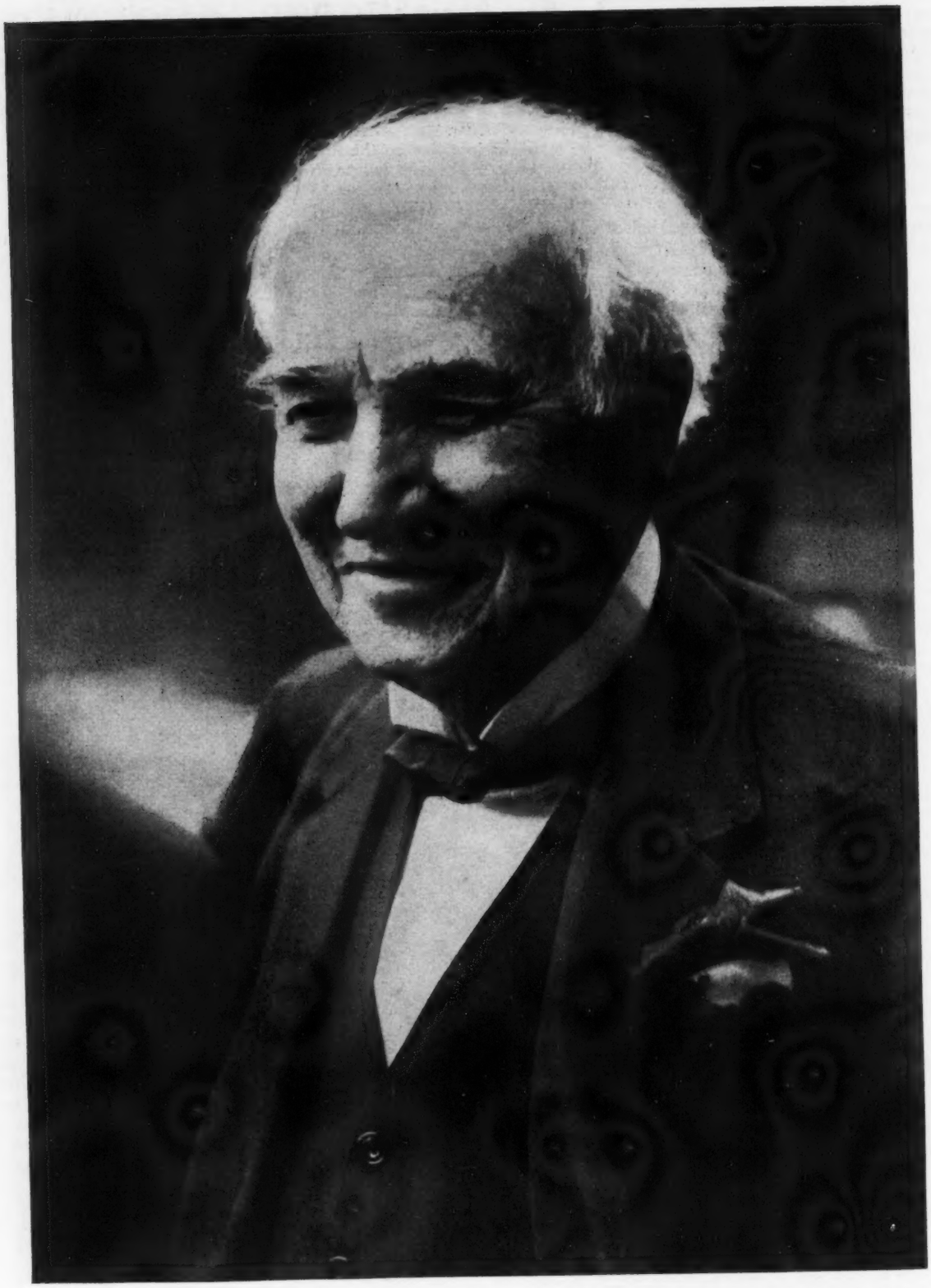
EDISON AND STRATTON

—Wide World Photos

Soon after paying tribute to Edison, Dr. S. W. Stratton, former president of the M.I.T., died suddenly at his Boston home on the same day as the leader he mourned. The photograph reproduced was taken at West Orange two years ago.

Minneapolis Rates to Be Cut $400,000 a Year

ELECTRIC RATES in Minneapolis will be reduced more than $400,000 a year, effective possibly by January 1. At the same time St. Paul, with which, as before reported, the Northern States Power Company is now negotiating for a new franchise, may be given a proportionate reduction. The company has offered St. Paul a decrease in rates of $241,000 provided that the city omits from the new franchise a 5 per cent gross earnings or sales tax requirement. Identical rate schedules now are in effect in the two cities, but refusal of St. Paul to eliminate the sales tax, which never has been required in Minneapolis, will result in giving the latter a rate advantage of approximately 5 per cent. The St. Paul electric franchise will expire December 31 and a new franchise must be approved by the people.



THOMAS ALVA EDISON
1847-1931

Thomas A. Edison Is Dead at 84

DEATH came to Thomas A. Edison at 3.24 a.m. Sunday, October 18, at his home in West Orange, N. J. His health had been poor since his return early in the summer from his winter home in Florida, and on August 1 a breakdown occurred which his physicians attributed to Bright's disease, diabetes, uremic poisoning and possibly gastric ulcers. After that date periodical rallies and the knowledge of his vigorous constitution, which had resisted a severe attack of pneumonia two years ago, encouraged his family and friends in the hope that the term of his long life would be extended still further. This hope was reluctantly abandoned two weeks before the end.

Mr. Edison's death brought not only nation-wide but world-wide mourning in its train. At first as the marvelous youth, then as the accepted miracle worker and finally as the Grand Old Man of his country, his contemporary fame spanned the terms of a dozen Presidents and, despite his own modesty, dimmed the renown of all other Americans who have worked in the same broad field of science and invention. It spread abroad further than that of any American coeval until in men's minds the electric age and the age of Edison became synonymous. When his death was announced tributes poured in in unprecedented number.

Mr. Edison's body lay in state in the library of his laboratory for more than two days, many thousands passing his bier. Only a few intimate friends and associates were present at the funeral service held at his home on Wednesday. The interment was in Rosedale Cemetery in Orange.

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Sketch of Edison's Life*

GENIUS—as distinct from talent—is frequently sterile. When it weds industry, as so seldom happens, greatness is born. Here is the secret of the marvelous career of Thomas Alva Edison. He himself has contributed to the world's familiar quotations the saying that "Genius is one-tenth inspiration and nine-tenths perspiration." In Edison's case the ingredients were more evenly mixed, for, unflagging as was his industry, had it not been combined with an inspirational faculty in equivalent proportion he could not have risen to the place almost universally accorded him—at the very apex of the great modern inventors who have revolutionized the material world. In any account of his career, however brief, this combination of traits should be borne in mind. Had he not been endowed with it, he would not stand out in sharp contrast alike from the men who conceive brilliant and true notions concerning the uses to which natural phenomena may be put but lack the driving power to transmute their theories into fact, and from the men who, without the power themselves to originate profound ideas, work ceaselessly and fruitfully in improving and extending the ideas of others. Edison was not, however, *sui generis*. Men of his type have been found in the electrical field from the first. But among those of his own day he was easily first.

Edison at 29

Strength of Character

Edison's intensely inquisitive youth was marked by a capacity for doing things, an insatiable thirst for knowledge, a fertility of resource and a passion for work unusual in the young. He early showed himself the possessor of keen reasoning powers and a tenacious memory. As a boy and through his young manhood he was untidy, perhaps a little uncouth, somewhat careless of his personal appearance, a spendthrift, even addicted to practical joking. With maturity and success these characteristics ceased to stand out, but he never became the sleek, well-groomed, standardized man of the world. Independent, democratic, no respecter of persons, a free thinker, a man who stood ever on his own feet, kindly to all but with small toleration for pretense or incompetence, an employer who inspired enthusiastic loyalty but a hard taskmaster withal, his character was not molded to pattern. A typical average American in many of his traits, he was an average American plus the fires of genius and plus the will power before which obstacles vanish and the impossible bows.

Edison's Boyhood and Youth

When Edison was born at Milan, Ohio, on February 11, 1847, Milan was a thriving village, like the contemporary Chicago, and built fallacious hopes of future greatness on the canal which connected it with the Huron River and had led to the erection of grain warehouses in the village. At that period the great cities of the country were lighted by gas, and telegraphy was in its not too vigorous infancy, the United States government having refused to buy the Morse system for $100,000 and the only long line in the country extending from New York City to Washington and from the latter city as far west as Pittsburgh.

The inventor came of Dutch ancestry —a fact curiously attested by the family pronunciation of the name with the "E" long. His great-grandfather, a United Empire Loyalist, removed to Nova Scotia after the American Revolution, where he lived to be 104. His grandfather reached 102. His father, a resident of Upper Canada, as Ontario was then called, reversed the ancestral record by taking part as a rebel in the Canadian *émeute* of 1837 and finding it in consequence expedient to remove to the United States. He, too, reached a ripe old age, becoming in his last years a frequent visitor to Menlo Park. Edison's mother, of long-lived Revolutionary stock, was born in New York State.

When steam railroads were built through the Middle West, Milan was left stranded and fell into ruin along with its boasted canal, and the Edison family moved in 1854 to Port Huron, Mich. Here the boy's father, a dealer in grain and feed, conducted a successful business, there being no truth in stories of the inventor's rise from abject poverty. At Port Huron young Thomas

*Indebtedness for facts and dates cited in the preparation of this sketch is acknowleged to "Edison: His Life and Inventions," by Frank Lewis Dyer, general counsel for the Edison Laboratories and allied interests, and the late Thomas Commerford Martin. A new edition of this book in which collaborated William Henry Meadowcroft, historian of the Edison Pioneers and long Mr. Edison's right-hand man, was issued in 1929 by Harper & Brothers.

had his only three months at school. He is said to have been always at the foot of the class, and the teacher pronounced him "addled." His mother, a former schoolteacher, knew better and took his education in hand herself, and to her he owed all of regular and systematically acquired knowledge that he gained in his youth. Incidentally, it is on record that, though a loving parent, she could chastise as well as teach.

Early Bent Was to Chemistry

The boy's early inclination was to chemistry—he became an electrician by chance—and many were his youthful experiments in that science. In 1859, at the age of twelve, he began to sell newspapers on the Grand Trunk Railroad accommodation trains between Port Huron and Detroit, having first tried out his hand as a news vender at home. With extraordinary enterprise for so young a boy, he started two stores in Port Huron—one for periodicals and one for vegetables and fruit, the former enduring for some time. On the outbreak of the Civil War his newspaper sales became profitable. When there was important news he would have a brief summary telegraphed from Detroit and placarded at the railway stations between there and Port Huron, and thus was enabled to dispose of great quantities of Detroit newspapers as he covered the route. Having picked up a knowledge of typesetting, he even printed a miniature paper of his own on the train, which he called the *Weekly Herald*.

Young Edison's chemical studies, however, wrought his ruin as a news vender. He had a diminutive laboratory in the car where he kept his stock in trade. A sudden jolt of the train one day upset jars and test tubes, and before he could prevent it flames burst forth and the car caught fire. The conductor of the train incontinently expelled the boy, forbade his return, and incidentally dealt him such a stunning blow on the ear that it set up the condition of deafness that lasted all through the inventor's life.

His youthful business thus wound up, Edison, who had been sedulously acquiring knowledge from the books in the Detroit free library and elsewhere, turned his attention to telegraphy, with which he had already an amateur acquaintance, and his real career began. He had the good fortune to rescue the child of the Port Huron station agent from peril, and the grateful father taught him train operating. His first situation was in Port Huron, his second in Stratford Junction, Ontario, where in 1863 he was earning $25 a month. From this place a failure to hold a train, for which he does not appear to have been to blame, led him to return suddenly to the United States, where, after temporary employment in Port Huron and Adrian, Mich., he started to wander.

There followed five arduous and adventurous years, during which he worked, among other places, in Detroit, Toledo, Indianapolis, Cincinnati, Louisville and, after the war was over, in Memphis and New Orleans. In these years he originated the method of vertical handwriting to which he always clung and which at one time, through its adoption in the public schools, gave promise of becoming universal in America. He also made successful experiments in which resided the germ of quadruplex telegraphy.

Reaching Boston toward the end of his wander-years, he expended part of his scanty savings in a complete set of the works of Faraday and is said to have tried every experiment recounted in them. Here he applied for his first patent—on June 1, 1869. It was No. 90,046 and was for an electromechanical vote recorder for use in the national House of Representatives and other legislative bodies. Agitated ever since, the idea is still unapplied at the national capital two generations later, though it has been applied in other legislative bodies.

Edison at 48

While in Boston Edison also invented his first stock ticker and started a ticker service, and he put up private telegraph lines between business establishments. With the stock ticker occupying his mind, he went to New York in 1869, without funds and much in debt. He had invented a system of duplex telegraphy, but failed to establish it. He could not sell his stock printer.

Fortune Takes a Turn

Into this discouraging period of his life came a change almost as dramatic as anything in fiction. Obtaining fortuitously the opportunity to show his skill in restoring a ticker service which had broken down while scores of New Yorkers were depending on it, he was put in charge of the plant at the to him unheard-of income of $300 a month.

Thus was the path to success and fame opened up to Edison before he had reached his twenty-third birthday. He had soon made improvements in the existing stock tickers and devised new ones. His work threw him into contact with Franklin L. Pope (afterward president of the American Institute of Electrical Engineers), and on October 1, 1869, they announced a partnership as "Pope, Edison & Company, electrical engineers and general telegraphic agency." J. N. Ashley became a member of the firm.

Soon after this Edison received $40,000 from the Gold & Stock Telegraph Company for a special ticker, for which the inexperienced youth (who is said to have presented the check at the bank unindorsed and, when this defect was remedied, to have prepared to carry away the rolls of small bills which a joking teller placed before him, not realizing that he could leave his newly acquired fortune on deposit) would, he afterward said, have taken $3,000. It was not long before he had opened a shop at Newark, N. J., to make the "Universal" stock ticker. Here were soon working at a single bench three men from Europe each destined to great success—Sigmund Bergmann and Sigmund Schuckert of Germany and John Kruesi of Switzerland. Large as the business was, the bookkeeping methods were of the most primitive kind.

The Newark shop soon grew to three, and, in addition to his stock ticker, Edison applied himself to improving the typewriter and to automatic duplex and quadruplex telegraph instruments. He made a trip in 1873 to England, where he succeeded, despite opposition, in demonstrating the merits of his telegraph systems. Eventually Jay Gould, who was then involved in a fight over the control of the telegraph business in America, paid him $30,000 for his patents. No fewer than 45 inventions were developed simultaneously at Newark. The hours of work were endless. Among these inventions was the mimeograph, perfected in 1875.

Edison and the Telephone

In the same year Edison, who, however, never disputed Bell's discovery of how to transmit speech, made, while pursuing investigations into harmonic telegraphy, a device crudely capable of use as a magneto telephone. His real contribution to telephony was the carbon transmitter which made it commercial in application. Edison sold this transmitter to the Western Union Telegraph Company for $100,000 in seventeen yearly payments, apparently not realizing that by this method he was

only collecting interest and losing the capital sum. He sold an electromotograph to the Western Union on the same terms and a chalk receiver or loud-speaking telephone to English interests for $150,000. Other telephonic inventions accompanied these.

The first phonograph, invented in 1877, built by Kruesi and preserved in the South Kensington Museum, London, was exhibited all over the civilized world and caused wide popular excitement. Edison's terms for this invention were $10,000 cash and 20 per cent royalty. The phonograph remained in a crude state for ten years; then it was improved and its use widely extended. After its first appearance it was followed by the telephonograph, the modern megaphone, the aërophone and the phonomotor.

Subdivision of the Electric Light

In 1878 Edison made a two months' trip to the West, visiting especially Wyoming and the Sacramento Valley. In Wyoming during a total eclipse of the sun he tested his tasimeter, which measured temperature to the millionth part of a degree Fahrenheit. Returning home refreshed, he attacked the great problem with the solution of which his name will ever be associated—the subdivision of the electric light—declared impossible by many eminent scientists. This monumental triumph was achieved in October, 1879. Edison's theory that the only possible means of accomplishing the desired end lay in the production of a lamp whose incandescing body should have a high resistance combined with a small radiating surface and be capable of being used in multiple so that each unit would be independent resulted in the carbonized paper filament.†

In the fall of 1879 hundreds of these lamps were in use at Menlo Park, N. J., whither Edison's workshops had been removed and where the new scheme of illumination attracted streams of visitors. The paper filament was followed by bamboo, and that eventually by artificial carbon; but before the latter stage was reached Edison had sent out agents at an expense of $100,000, which he met himself, to Jamaica, Cuba, Brazil and other tropical South American countries, Ceylon, India, the Malay Peninsula and Japan, to seek for suitable indigenous fiber—a striking illustration of the inventor's thoroughness and determination and one of the many romantic episodes associated with his career.

The Menlo Park Laboratory

The Menlo Park laboratory was started in 1876. Edison's associates there were Charles Batchelor, Frank Upton, Francis Jehl, William J. Hammer, Martin Force, John W. Lawson, Ludwig K. Boehm and John Kruesi. Of these pioneers of incandescent lighting Jehl and Hammer alone survive. E. H. Johnson was the inventor's traveling representative and spent much time in Europe in his interest, and Samuel Insull, then a young Englishman, was his private secretary and much-needed financial manager.

Concurrently with his lighting development, Edison attacked the generator problem and raised dynamo efficiency from 40 to 90 per cent. One effort along his path involved the design of a dynamo for the ill-fated *Jeannette*, soon to repose at the bottom of the Arctic.

A Few of Edison's Inventions

Approximate Date

1868—Electrographic vote recorder.
1869-1878—Telegraphic repeaters, quadruplex and sextuplex telegraph, printing telegraph, etc.
1875—Electric pen and mimeograph.
1876—Carbon telephone transmitter.
1876—Microtasimeter.
1877—Megaphone.
1877—Phonograph.
1879—INCANDESCENT LAMP AND LIGHT SYSTEM.
1884—Electric valve ("Edison effect").
1886—Wireless telegraph to and from moving trains.
1889—Kinetoscope.
1900—Storage battery.

Inventing the incandescent light and improving the dynamo were not, however, enough. To make this great achievement complete, a system of lighting had to accompany it. As Edison conceived it—and his conception has stood firm, unimproved and unchanged, to this day—such a system involved dynamos, regulating devices, underground distribution of energy, protective devices and meters. This prodigious task the inventor tackled with all his tireless energy, and in January, 1889, his first patent application for a "system of electrical distribution" was signed. From 1880 to 1900 no less than 375 patents were issued to him, divided as follows: Incandescent lamps and their manufacture, 149; distributing systems and their control regulation, 77; dynamo-electric machines and accessories, 106; minor parts, sockets, switches, meters, etc., 43. Seventy-eight additional patents were lost through a swindling patent attorney who did not file the applications. A dynamo was shipped to Paris for the Exposition of 1881.

Pearl Street Is Born

In chronological sequence comes the familiar story of Pearl Street, New York. Here, against the opposition of the gas industry and the arc-lighting interests, incandescent lighting won its way. Three of the six "Jumbo" dynamos built for this first central station (255 and 257 Pearl Street) were installed in May, 1882. On July 5 the first one was operated, and on July 8 one thousand lamps were lighted experimentally. On September 4, 1882, the station started. Almost simultaneously began the small water-power station at Appleton, Wis. Brockton, Mass., and Sunbury, Pa., were chosen by Edison to try out his early plans. Lawrence and Fall River, Mass., and Newburgh, N. Y., were the sites of other pioneer plants. In a few years every city of importance in the United States and Canada had its central electric station. In Europe, Paris, London, Milan and Berlin, under the guidance of Edison-trained men, led the way. The Edison General Electric Company, capitalized at $12,000,000, came into being. Shares of the Edison Electric Illuminating Company of New York, organized in December, 1880, rose speedily from $100 to $3,500 in value.

Edison's Electric Locomotive

Edison had invented an electric motor before he perfected the incandescent lamp. Early in 1880 he began the construction of a stretch of track close to the Menlo Park laboratory and at the same time built an electric locomotive to operate over it. The first track was about a third of a mile in length, this being increased afterward to 2½ miles. Operation on this miniature line was successful. In 1883 patents of Edison and Stephen D. Field were exploited on an early third-rail exhibition track built at Chicago. Edison never followed up his inventions in the traction field. He was later interested in storage-battery cars, but the overhead trolley drove them from the field. He went to Europe in 1889 and installed a hundred-thousand-dollar exhibit at the Paris Exposition of that year.

Only passing allusion can be made here to the five years' hard work (1897-1902) which Edison bestowed on the magnetic separation of iron ores, culminating in the construction of a great concentrating plant at Edison, N. J., at a cost of $2,000,000, largely the inventor's money. The plan failed commercially because the discovery of immense deposits of rich Bessemer ore in the Mesaba range in Minnesota cut

†It is true that Edison's precedence as inventor of the incandescent lamp has been attacked, and there seems no doubt that Sir Joseph Swan of England made a demonstration of such a lamp ten months before Edison's invention was ready. Whether Swan's lamp was or was not commercially practicable, it remained only a laboratory experiment. Thus, whatever Swan and others may have accomplished in the direction where many technicians were working, it was Edison who *did* commercialize his independent invention, devised the electric central station and thus founded the electrical industry.

the market price of crude ore in half. He followed this enterprise with a plant for the manufacture of portland cement, which was made to pay, although the inexpensive "poured-cement houses" foretold by the inventor failed to make their appearance in large number.

Of more lasting importance was his part in the great motion-picture industry, an enterprise in his proper field. In 1889 the first modern motion-picture camera was made as the result of Edison's production of a device by which from thirty to forty pictures could be taken in a second with great fineness of adjustment. From that day the Edison camera became the accepted standard for obtaining pictures of objects in motion.

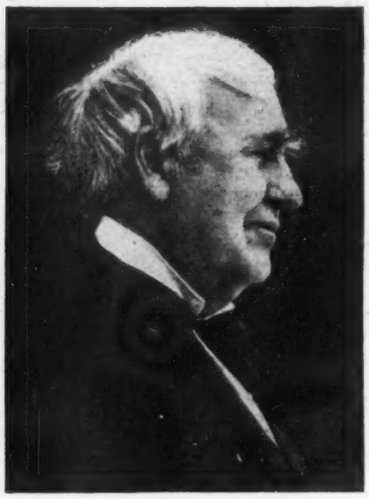
Storage Battery and Other Inventions

More than ten thousand experiments are said to have been made in bringing the Edison storage battery to its present state. It was a ten years' job, and for a long time the batteries were withdrawn from the market because they did not measure up to the exacting ideal of the inventor. The battery, now extensively employed in traction and commercial hauling, deserves to rank among the important achievements even of an Edison. Other inventions which it is impossible to do more than name are the device permitting telegraphing between stations and moving trains (a forerunner of wireless transmission), the fluorscope (made after the discovery of X-rays), the Edison-Sims torpedo (developed in conjunction with W. Scott Sims), the pyromagnetic generator to produce energy directly from heat, and the odorscope to determine the presence of gases or vapors.

The list of electric contrivances is almost endless. More than a thousand patents have been granted in Edison's own name. The records of the experiments made in his laboratory, which was moved from Menlo Park to West Orange, N. J., in 1887, are contained in hundreds of notebooks of 200 pages each, 8½ in. x 6 in. in size. In this one respect at least Edison showed a devotion to system, and he always denied that his methods, except where chemistry was concerned, were empirical. The library at West Orange, where the plant has grown to elaborate proportions, contains thousands of volumes on science of every kind.

At this great plant work for many years went on incessantly, sometimes all night, often seven days a week; but Edison was always reputed to work harder and longer than any one else, needing but little sleep, which little he could snatch anywhere and at any time, and having marvelous powers of endurance and recuperation. Up to 1902 his biographers estimate his average day's working hours at nineteen and one-half, after that, for years, at eighteen. He preferred invention to manufacture and was, as has already been intimated, far from a born business man, though he developed a shrewd perception of manufacturing possibilities that brought him wealth, despite the reputed fact that he never made a cent from his light and power patents. He exercised unceasing vigilance in devising means of improving the quality of his products and increasing the economy of their manufacture in the great workshops grouped around the laboratories.

With the opening of 1930 the investment in the United States alone in the light and power industry, the electric railways and the electrical manufacturing industry—all founded in whole or part on Edison's inventions—was nineteen and a half billion dollars; the annual gross revenue was more than six billions, and the annual capital additions were a billion and a quarter. The combined capitalization of electric light and power companies alone in the United States is now put at eleven billion eight hundred million dollars, the invested capital of the great electric manufacturing companies approximates three billions, and the valuation of all affected industries of every sort would reach figures of almost astronomical dimensions. The effect of Edison's inventions on the single item of copper has been incalculably vast.



Edison at 80

Honors and War Work

Though Edison cared nothing for decorations of any kind and had little respect for college graduates as such, he was made the recipient of honorary degrees from Union College, Princeton University and the University of the State of New York. The French government made him a chevalier, officer and finally commander of the Legion of Honor. He received the John Fritz medal in 1908 and the Rathenau (German) medal in 1914. He was chief consulting engineer of the St. Louis Exposition in 1904. In 1929 he was the hero of the protracted celebration of the semi-centennial of his invention of the incandescent electric light. Elaborate programs and spectacular lighting all over the United States and in other nations as well culminated at Dearborn, Mich., where Henry Ford has established an institution in the inventor's honor. Mr. Edison was present at the memorable banquet there on October 21, the exact anniversary of his first demonstration of his lamp.

When the World War was being waged in 1915 the United States government made him president of the Naval Consulting Board, and until the proclamation of the armistice he devoted much of his time to a study of war problems and the elaboration of devices to strengthen the United States forces. These devices numbered fifteen or twenty. At this period he also designed, built and operated a number of chemical plants for the government. Active almost to the end, the last two or three years of the inventor's life were spent in experimenting with American plants in an effort to obtain raw material from which rubber could be made.

Mr. Edison's Character

Mr. Edison's character has perhaps been sufficiently indicated already. Courageous, optimistic, unsentimental, loving to overcome obstacles, charitable in his impulses and adhering to high moral standards, he united iron nerve with an active imagination. Usually phlegmatic, he could be roused to anger by faults in others, particularly—among the more venial shortcomings—those of laziness and incompetence. His philosophic cast of mind was shown by the view he took of his own deafness, which he held had an advantage in facilitating concentration upon the task in hand. His religious views were summed up by himself as embodied in a belief in the existence of "some vast intelligence governing this and other planets." He was a man without any hobbies apart from his work, unless a love of sketching could be called one.

Mr. Edison was married first in 1873 to Mary Stillwell, who died in 1884, leaving three children. A second marriage took place in 1886 to Mina Miller, who survives him. Three children were also born of the second marriage. He made his home for many years near his beloved laboratory, in Llewellyn Park, on Orange Mountain, N. J. He also had a home, with a laboratory, at Fort Myers, Fla., where he was accustomed to spend most or all of the winter.

EDITORIALS

L.W.W.MORROW
Editor

Thomas Alva Edison

THERE have been many men since the dawn of history who left their mark upon the world—kings and presidents, philosophers and poets, scientists and explorers, great hearts and religious leaders; but it is to be doubted if in all the centuries there have been more than a very few who so thoroughly changed the lot of man as did Thomas A. Edison. Certainly no one has ever so altered the world in the space of his own lifetime as he who this week dropped weary hands from the self-appointed tasks which his heart still longed to do but which the "all too human flesh" could no longer be driven to accomplish.

Edison gone? One wonders. Everywhere, whether in city or hamlet, on great ocean liners, in roaring trains, in streaking airships or in underseas craft, the electric lamp gleams in tireless continuity where and when man wills it. Darkness is no more. Is not this indeed Edison? Is he not always to be here? Phonographs, motion pictures, telephony, telegraphy, the radio and an infinite host of related twentieth-century comforts, conveniences and necessities pay tribute in whole or in part to his tireless ingenuity.

No man leaves this world of the instant; least of all the great. The deeds of each live on variably as the influences cultivated perish little by little or proceed by evolution to extinguishment. Edison as the man whom one might shake by the hand and be welcomed with a ready smile is beyond our didacticisms, but it will be decades and even centuries before he is truly gone.

As a scientist he must yield place to an infinite throng of earnest and serious men. As a philosopher he often ventured beyond his depth. As a business man he was not among the most successful. But as a giver of gifts such as no other man could present to untold millions of contemporaries and to generations yet to be, he is without peer in all the days of man. Without acceptance for himself of the infinite rewards of leisure, he gave leisure as well as work to his fellow men of smaller stature. Edison will outlive the great-grandchildren of men yet unborn.

Utility management now professional

SOMETIMES statements about the utility industry by outsiders are stimulating and competent. For example, Philip Cabot in this issue points out certain trends and states his convictions bluntly and vigorously. One may agree or disagree with him and yet be stimulated to thoughtful consideration of his suggestions.

Especially pertinent comments are made about utility management and managers. The age of the promoter, the engineer-builder, the banker or the lawyer as a utility manager has passed. In this stabilized marketing stage the utility manager must have a professional viewpoint. The interests of customers, investors and the public have merged, and the type of leader required is the "scientific industrial philosopher whose dominant motive is not private profit but the service of mankind. For him profit is the score but not the game; the game is to develop the maximum volume of profitable business in his field."

Very little study is required to agree with Professor Cabot that the manager of a utility property today must be an able and rounded executive whose primary duty is to develop his markets intelligently. It is also evident that this leadership must be exercised on each property and cannot be reflected from holding-company headquarters with positive success. Power in management must be vested in property managers, and only policy and

counsel should emanate from financial headquarters. The day of the individual owner-manager as well as of the distant financial manager has passed, and multiple owners now must find and develop local professional utility managers.

I. E. S. completes its first quarter century

LAST week the Illuminating Engineering Society held its silver anniversary convention, but there was little time devoted to reminiscent flutterings of the pages of twenty-five years of accomplishment. Today's problems and tomorrow's crowded out the past. Co-operation with architects and the adoption of built-in sources will continue to revolutionize the lighting of new structures of all kinds if the thinking and action of America's leading illuminating engineers mean anything. Ultra-violet radiation may be of somewhat undefined general value, but the world is going to have a lot more information about it than now constitutes common knowledge and is going to use more of it, too, in play and work spaces. Intensities are still far too low to suit the lighters of America. The home is to be a center of action for and toward improved practices. Here, in brief résumé, is the spirit of the meeting.

It is unfortunate that lighting practices should lag so far behind the thinking of illuminating engineers. For example, there was exhibited at the convention one of the most startling arrays of stuck-on, hang-down, "geegawy" reactionary fixtures that the most pessimistic individual could hope to see. The new era in lighting is far removed from the present so far as general acceptance is concerned if such gadgets as those there displayed are to constitute the opportunities for choice by John and Mary Jones. Some one should, and even in these lean days probably could, make a well-deserved fortune by offering modern fixtures combining with technical excellence the esthetic virtues of simplicity, good taste, dignity and reserve.

Around the virtues of ultra-violet irradiation as a health retainer and promoter much discussion centered. The lack of any acceptable measure of either ultra-violet quantities or standards of therapeutic value complicates the problem, likened by one speaker to measuring quantities by means of a meter with a pointer but without a scale. The whole question could be solved beyond all argument by the production of sources which would accurately simulate sunlight instead of emphasizing certain wave lengths as at present.

Illuminating engineers are continuing the good work which a quarter century of organized effort has but begun. They have built a world of light upon development from fundamental facts through co-operative efforts. The future holds bright promise. The next quarter century in the history of the Illuminating Engineering Society should bring new marvels. One may well wish its earnest members godspeed.

Rural service on a socialized basis

WHY not, suggested Public Service Commissioner Maurice C. Burritt of New York in last week's issue of the ELECTRICAL WORLD, consider community areas in serving electric utility customers rather than segregate urban and rural service problems? Why not establish community areas (only those susceptible of integrated future development) and carry service to each and every resident on an identical basis instead of establishing line extension rules and charges in discrimination against the consumer far removed from load centers? Why not, he further suggests, make all rates low enough to enable the users of even small quantities of energy to obtain theirs at over-all figures which will be low for each kilowatt-hour—all on a community basis founded upon democratic equality of rights, benefits and costs?

Perhaps this is but one sign of the times. Perhaps it foreshadows the definite action of the future. Certainly the annual convention of the Empire State Gas and Electric Association welcomed Mr. Burritt's remarks eagerly enough. But Mr. Burritt has assumed grave responsibilities when he insists that a parallel to the postal system is involved and that the many who may be supplied cheaply should today bear the burden of cost in supplying dearly the few who live far from the many and offer vastly different economic values.

Mr. Burritt has made tangible suggestions toward the solution of a perplexing problem, but we doubt whether they will work, should work, or are based upon sound principles. To extend lines and service to large rural areas merely on the assumption of possible future development would constitute an inequitable burden on those who today are profitable customers. No such obligation is or could be imposed on common carriers, for example. The rights and interests of the majority have hitherto ruled over the rights of all and, if the very foundations of our concept of organized society are to stand, should continue to offer the deciding influence in the face of proposals regarding socialized community rights.

Two fundamental reasons for trouble with dealers

AT THE bottom of nearly every case of bad relations with retail dealers arising out of utility merchandising will be found two things fundamentally wrong. The one that has caused most trouble is the overzealous salesman working on straight commission and grabbing every sale he can. The obvious reason for compensation by commission is, of course, to furnish an incentive for the salesman to hustle. However, utilities that pay their salesmen a salary plus a small bonus of some kind, based on total business done, load-building value of appliances sold, quotas made or some other consideration, find that they get just as good results and in addition enjoy friendly trade relations. Moreover, when a man is paid a salary the company has a right to expect and demand his full time and best efforts and is able to dictate sound and ethical sales methods. It cannot control so well a man working on his own time.

The other important element that enters into bad relations with dealers is lack of continuous contact between the utility and the dealers. The utility could well afford to have a man of good personality, with a proper knowledge of the utility business and an appreciation of the dealer's problems and his right to fair treatment, whose sole duty it would be to keep the company in friendly contact with dealers.

If utilities will maintain fair policies as to prices and terms, straighten out their compensation methods and maintain a close contact with the dealers, it will do much to establish friendly relations and to serve adequately the tremendous market that exists for completely electrified home service.

Detroit tries out high temperature

IMPROVED efficiency in electrical production from fuel-burning stations is very largely dependent upon the use of higher temperatures. At present practice is limited to 825-degree steam as an upper value because of the failure of known materials to stand up at higher temperatures. In an endeavor to try out new alloys and materials and to develop data on thermal performance the Detroit Edison Company has made an experimental installation of a 10,000-kw. turbo-generator supplied by steam from a separately fired superheater capable of delivering steam at a temperature over 1,000 degrees. The results of the experiment to date are outlined in this issue by Paul W. Thompson. They indicate encouraging progress, although as yet the steam used has reached an upper temperature limit of only 850 degrees.

This notable installation should be encouraged because the only way to overcome material limitations is to experiment on the scale adopted at Detroit. Before any commercial decision can be reached some time must elapse and a great amount of experimentation must be done, but the final answer will be invaluable to the industry. In the meantime very general agreement exists that the next group of commercial power stations should embody designs with steam at about 600 pounds and temperatures at 800 or 825 degrees without reheat. The use of these values and the unit boiler-turbine-generator principle permits station installations at cost ranges from $75 to $85 per kilowatt and operating performances at high thermal efficiency and low labor and maintenance values. Thus, until higher temperature materials are found available, there appears no path to improved economy in steam-power production. It is therefore to be hoped that the Detroit experiment will quickly arrive at fruitful results.

High-Temperature Turbine Experiment

By P. W. THOMPSON

Chief Engineer of Power Plants
Detroit Edison Company, Detroit, Mich.

STEAM temperatures exceeding 850 deg. F. have been reached so far in the operation of the Detroit Edison Company's high-temperature turbine and superheater installation in its Delray power house No. 3. The turbine itself was put into operation on station steam in October, 1930, but difficulties encountered by the manufacturer in fabricating the special alloy tubes delayed the completion of installation of the superheater until July, 1931. The intervening eight months were profitable as they afforded the operators an opportunity to become thoroughly familiar with the unit and permitted the establishing of proper running clearances in the machine.

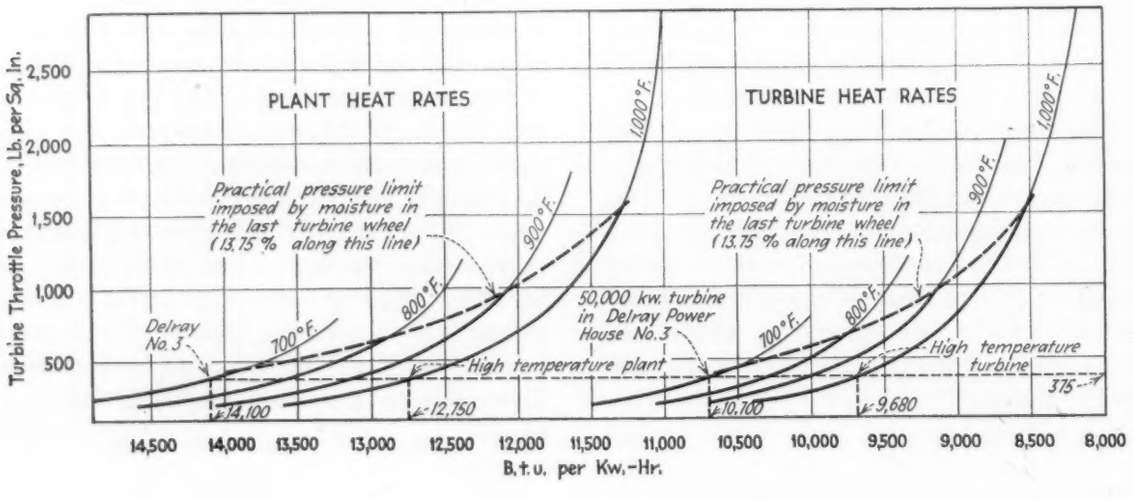
It is proposed gradually to increase the steam temperature in 25 deg. or 50 deg. increments, each operating for a sufficiently long period of time at each temperature above 800 deg. to give reasonable assurance that all turbine and superheater parts are in good order, before proceeding to the next higher temperature run. No predictions can be made as to whether the upper limit will be 1,000 deg. or some lower temperature. It may take two or three years to determine the maximum temperature consistent with good turbine operation, but the determination of this fact will have fulfilled the object of the experiment.

The decision by the Detroit Edison Company to install a sizable experimental turbine to operate with 1,000 deg. F. steam was made in order to increase our knowledge of the behavior of alloy steels at elevated temperatures, thereby removing the limitation heretofore imposed on the efficiency of the simple regenerative cycle. Increase in the efficiency of turbines operating on the simple regenerative cycle has been limited by two considerations: First, that moisture in the exhaust must not exceed 13 to 14 per cent if rapid wear of the blading in the lower pressure stages is to be avoided; second, that prior to 1930, 750 deg. F. was commonly accepted by designers as the highest safe temperature for materials used in superheaters, piping and turbines. These materials, while satisfactory for temperatures up to 750 deg. actually grow appreciably under stress when subjected to higher temperatures; the amount of growth (or creep, as it is called) increases as the stress or temperature is increased. The materials subjected to the high temperatures in this installation were chosen, and so designed for upper values of stress that the amount of creep over the probable life of this or similarly designed commercial equipment would not result in failure of any part.

Heretofore the temperature limitations have determined the choice of 400 to 450 lb. initial turbine pressure as the upper limit for the straight regenerative cycle in this country. Several European plants, however, have been successfully using 600 lb. and 850 deg. F. steam for several years. Operation difficulties and markedly greater

Effect of increasing pressure and temperature

In a simple regenerative cycle with three stages of extraction for feedwater heating and exhausting to a back pressure of 1 in. of mercury absolute these curves show the improvements in heat rate by raising steam pressures and temperatures. The turbine heat rate curves show that for the 50,000-kw. units in Delray power house No. 3 with initial steam conditions of 375 lb. gage and 700 deg. F. at the throttle a heat rate of 10,700 B.t.u. per kilowatt-hour is attained. An increase of 300 deg. F. in the steam temperature and a decrease of 10 lb. in the pressure indicates a heat rate of 9,680 B.t.u. per kilowatt-hour for the new high-temperature turbine. This temperature increase means an improvement of 3.36 points in thermal efficiency. The Delray plant heat rate is shown at 14,100 B.t.u per kilowatt-hour, while the rate for the same plant using 1,000 deg. F. steam would be 12,750 B.t.u. per kilowatt-hour, a thermal efficiency gain of 2.56 points.



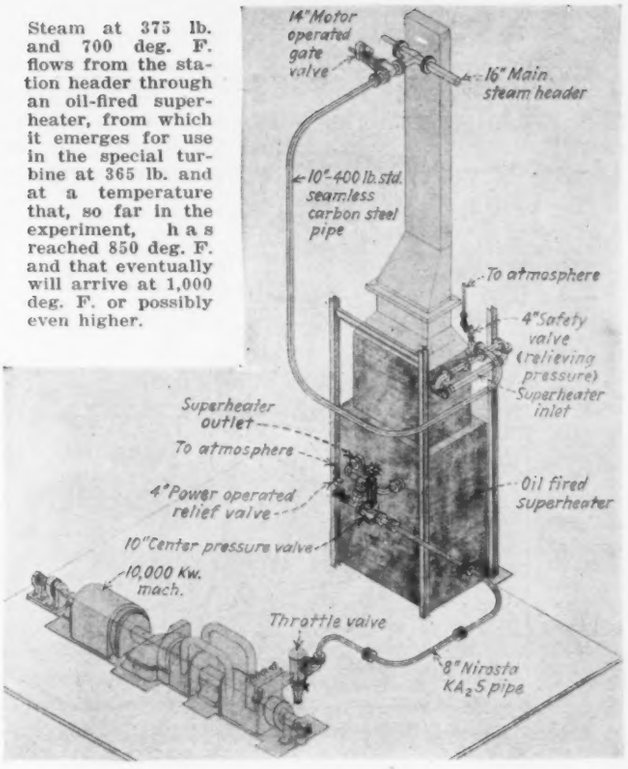
Making Progress

Reasons why Detroit Edison decided to try out high temperature installation.

Special design features of turbine and superheater.

Arrangements for continuous check on turbine performance.

Metal stress at 1,000 deg. F.



Steam at 375 lb. and 700 deg. F. flows from the station header through an oil-fired superheater, from which it emerges for use in the special turbine at 365 lb. and at a temperature that, so far in the experiment, has reached 850 deg. F. and that eventually will arrive at 1,000 deg. F. or possibly even higher.

Detroit Edison's high-temperature experiment

investment costs have restricted the use of the high-pressure reheating cycle to plants with high load factors. The theoretical increase in efficiency and the savings to be effected by the use of higher steam temperatures and pressures are shown in the accompanying graphs.

In order not to complicate the equipment necessary for the experimental installation, a steam pressure higher than 400 lb. was not selected. A higher pressure, which might be economically justifiable in a plant to utilize a steam temperature of 1,000 deg., would, in this experimental installation, have required the addition of new steam-generating apparatus, with attendant greater investment cost and more involved operation. For the purposes of this experiment it was felt there would be nothing gained by going to a pressure higher than the normal station steam supply.

Small superheater tried out first

As a preliminary to the Delray installation* a small oil-fired superheater capable of raising the temperature of 6,000 lb. of steam per hour from 700 deg. F. to 1,100 deg. F. was installed in an unoccupied boiler position at the Trenton Channel plant of the company. Experience with this unit served as a guide in the design of the piping and of the larger superheater as installed at Delray. This small superheater with its discharge piping has now been in operation for 11,830 hours, up to August 31, 1931, delivering steam at 900 deg. F. to 1,100 deg. F. with no indication of trouble. Tests made on a pipe section removed after 6,400 hours of service showed that the 18 per cent chromium, 8 per cent nickel alloy steel from which is was made had undergone only slight deterioration due to carbide segregation. It is planned to continue operating this preliminary experimental installation for some time so that it may serve as an indicator of any trouble which may be encountered later with the Delray equipment.

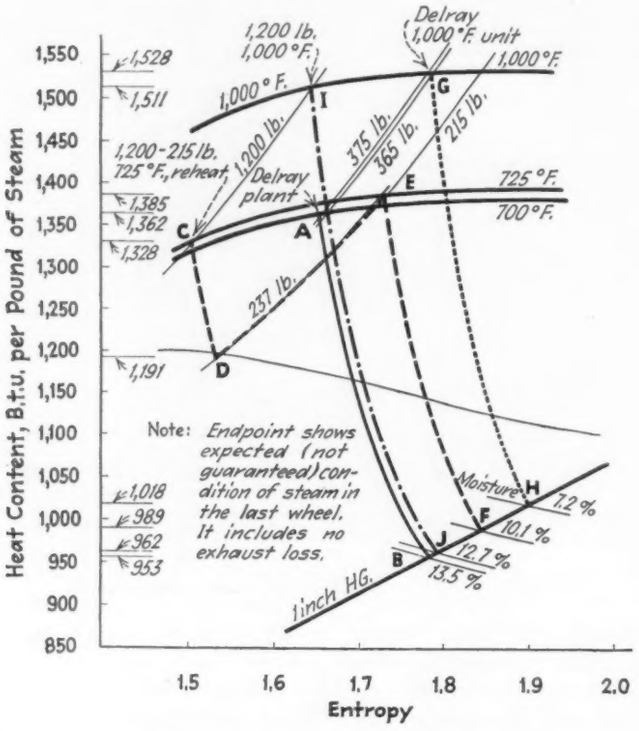
An important part of the experiment will be the keeping of a complete history of all the various materials that have been used in the several parts of the superheater, piping and turbine. In all cases where it has been possible samples have been secured from parts while they were being fabricated. These samples have been stored and will be used for comparison with their respective parts when they are removed for metallurgical examination in the future. Various initial measurements have been taken on all parts of the turbine, piping and superheater to serve as a base for determining any creep that may take place during the life of the installation. These measurements will be repeated and recorded at periodic intervals and will serve as a warning of any severe growth that might result eventually in failure. Photographs for future reference have also been taken of all parts that will be subjected to change or deterioration under the action of high temperature steam and have been added to the permanent data already collected.

Creep values have been obtained under the supervision of Prof. A. E. White, University of Michigan, on four alloy steels to form a part of the permanent data being kept. A cast Cr-Ni-Mo alloy was selected by the turbine designer for use throughout the high-pressure cylinder in all parts subjected to high temperatures; 5,000 lb. per square inch was the maximum working stress used with this steel. A cast chromium-tungsten steel recommended by V. T. Malcolm was used for the reducing elbow at the inlet of the throttle valve. A cast molybdenum steel, the composition of which was suggested by R. W. Bailey, was used for the 10x8-in. reducer at the outlet from the superheater. Nirosta KA2, the common 18 Cr-8 Ni austenitic alloy, was used for all castings and forgings in the superheater subjected to steam above 850 deg. F. KA2S, similar to KA2 except in carbon content, which is under 0.07 per cent, was used for the 8-in. steam main. "Era 131," an English alloy, was used for the body of the 10-in. center pressure valve,

*See "1,000-Deg. F. Turbine for Delray," by J. W. Parker, "Power," May 28, 1929.

located at the outlet of the superheater. This valve was supplied by Hopkinsons, Ltd., of Huddersfield, England.

The 10,000-kw. British Thomson-Houston turbine has been designed to operate with 365 lb. per square inch gage and 1,000 deg. F. initial steam at 3,600 r.p.m. and exhausting to the condenser at 1 in. absolute pressure (Hg). The turbine is a two-cylinder tandem compound



Four cycles, existing and possible

The expansion lines on this Mollier diagram show, graphically, the conditions of four different turbine cycles, two of which are in commercial use, the third in experimentation as described in this article and the fourth a speculation. Line A-B shows the initial and exhaust conditions of steam utilized in the Delray No. 3 units. Line A-G-H illustrates the use made of the steam in the high-temperature turbine. Line C-D-E-F shows the various steam conditions in a 1,200 to 215 lb., 725 deg. F. reheat cycle. Line I-J is the expansion line of a turbine using initial steam at 1,200 lb. and 1,000 deg. F. The thermal efficiencies of the above four cycles are 31.9 per cent, 35.3 per cent, 37.7 per cent and 39.6 per cent, respectively.

of the impulse type with nine stages in the high-pressure cylinder and eleven stages in the low-pressure cylinder. Steam for feedwater heating is extracted at the ninth, fourteenth and seventeenth stages. Governing is of the partial admission or cut-out type with five control valves operated from a camshaft, which in turn is operated by an oil servo-motor controlled by the governor. The governor is of the flyball type, driven directly from the turbine shaft through a worm and pinion. Three unusual features can be noted in the high-pressure cylinder from the accompanying cross-section of the turbine. These features are the amount of shaft packing at the high-pressure end of the cylinder, the large first-stage wheel and the double casing.

The extended shaft packing was made long enough to allow the leak-off steam to cool the shaft and keep as much heat as possible from the No. 1 bearing. Saturated steam will be admitted to the annular space next to the first stage at a pressure, automatically controlled, slightly in excess of the first-stage pressure, in order to prevent a flow of high temperature steam outward. Leak-off from this packing will supply the seals in the remainder of the turbine. No shaft water seals have been provided. The amount of work done by the first-stage wheel and the resultant temperature drop will tend to concentrate the high temperature to the front end of the machine. The first-stage wheel with full load on the turbine and 1,000 deg. F. steam will deliver 848 kw. Under these conditions the steam temperature leaving the first wheel will be 925 deg. F.

The conventional bolted type joint was not used for the casing of the high-pressure cylinder because of the trouble anticipated with such design, due to high temperatures. Instead, a solid outer casing with an inner split casing to hold the diaphragms was used. The erection of the turbine is somewhat complicated by this type of construction, as it is necessary to upend the entire cylinder assembly before it can either be assembled or dismantled. A special lifting tackle, supplied by the manufacturer and requiring the use of two crane hooks, facilitates this operation.

The high and low pressure thrust bearings of the marine type are mounted in the center bearing pedestal on either side of the coupling. Rugged clearance indicators are mounted on each cylinder to indicate the amount of axial movement. The high-pressure cylinder indicator will be particularly useful in indicating the amount of movement resulting from thermal expansion.

The steam cycle

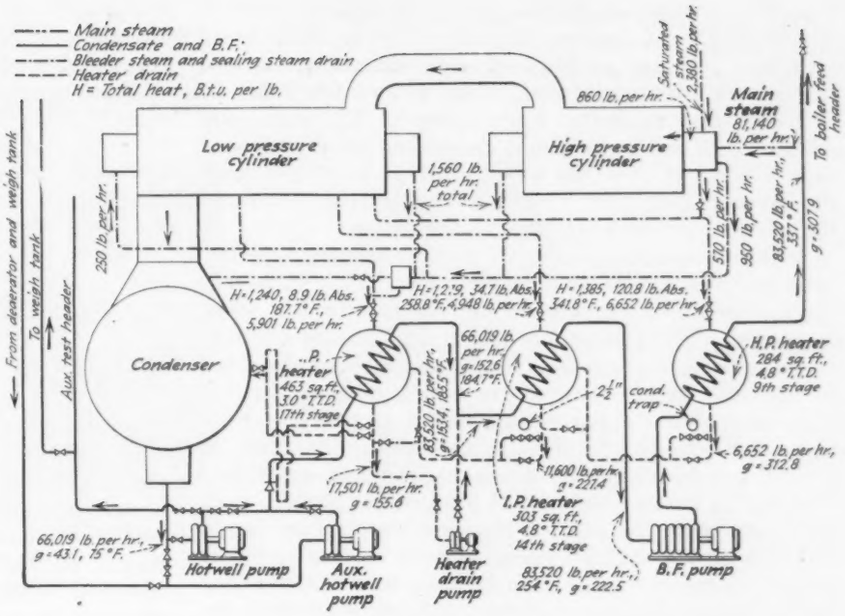
High-temperature steam is supplied to the turbine, together with a small amount of saturated steam which normally leaks into the first stage from the saturated steam sealing space. It is expanded through the high-pressure cylinder with extraction from the first stage and thence on through the low-presure cylinder to the condenser with extraction at the fourteenth and seventeenth stages. The condensate is picked up from the condenser by the hotwell pump and discharged through the seventeenth and fourteenth stage heaters into the suction of the boiler feed pump. This pump discharges through the ninth-stage heater into the main station boiler feed system. The heater drains are cascaded into the seventeenth stage heater, where they are picked up by a drain pump and discharged into the main condensate circuit between the seventeenth and fourteenth stage heaters.

In case of trouble with the heater drain pump, the drains will discharge directly into the condenser through a U-seal which has been provided for this contingency. Leak-off from the inner high-pressure saturated steam space in the high-pressure cylinder is condensed in the ninth-stage heater. Leak-off steam from the outer high-pressure sealing space and the steam from the low-pressure end of the high-pressure cylinder combine with the leak-off from the high-pressure seal on the low-pressure cylinder to furnish steam for the low-pressure seal on the low-pressure cylinder. The excess normally goes to the seventeenth-stage heater through a special reducing valve, or it can be turned into the condenser.

Provisions have been made for making weighed water tests while the feedwater heaters are in service in order to check the designed heat rate of the unit. The condensate will be picked up from the condenser by the hotwell pump, sent to the weigh tanks, and then returned to the suction of the auxiliary hotwell pump, where it

From 1,000 to 75 deg. F.

The turbine is bled for feedwater heating at the ninth, fourteenth and seventeenth stages. The heaters also utilize the discharge of saturated steam that is used for sealing. An auxiliary hotwell pump and special weigh tank piping facilitate test runs.


Main steam
Condensate and B.F.
Bleeder steam and sealing steam drain
Heater drain
H = Total heat, B.t.u. per lb.
Low pressure cylinder
High pressure cylinder
860 lb. per hr.
Saturated steam 2,380 lb. per hr.
Main steam 81,140 lb. per hr.
To boiler feed header
1,560 lb. per hr. total
250 lb. per hr.
510 lb. per hr.
980 lb. per hr.
83,520 lb. per hr., 337° F., g = 307.9
From deaerator and weigh tank
To weigh tank
Aux. test header
Condenser
H = 1,240, 8.9 lb. Abs. 187.7° F., 5,901 lb. per hr.
H = 1,219, 34.7 lb. Abs. 258.8° F., 4,948 lb. per hr.
H = 1,385, 120.8 lb. Abs. 341.8° F., 6,652 lb. per hr.
66,019 lb. per hr., g = 152.6, 184.7° F.
83,520 lb. per hr., g = 183.4, 185.5° F.
L.P. heater 463 sq. ft., 3.0° T.T.D. 17th stage
H.P. heater 284 sq. ft., 4.8° T.T.D. 9th stage
2½" cond. trap
6,652 lb. per hr., g = 312.8
11,600 lb. per hr., g = 221.4
I.P. heater 303 sq. ft., 4.8° T.T.D. 14th stage
17,501 lb. per hr. g = 155.6
66,019 lb. per hr., g = 43.1, 75° F.
Hotwell pump
Aux. hotwell pump
Heater drain pump
83,520 lb. per hr., 254° F., g = 222.5
B.F. pump

will resume its normal course. By maintaining a constant level of water in the system at the receiving tank, located under the weigh tanks, the same rate of flow of water can be maintained through the extraction heaters during a weighed water test as would normally be passing through the heaters were the units not under test. During test runs the heater drain pump will be cut out and the condensate from the heaters will go directly to the condenser. All valve positions necessary for test purposes have been double valved, with open drains placed between each pair to prevent any leakage to or from the system. Permanent test thermometer wells and connections for test pressure gages have been provided at all points required to permit the taking of complete test data.

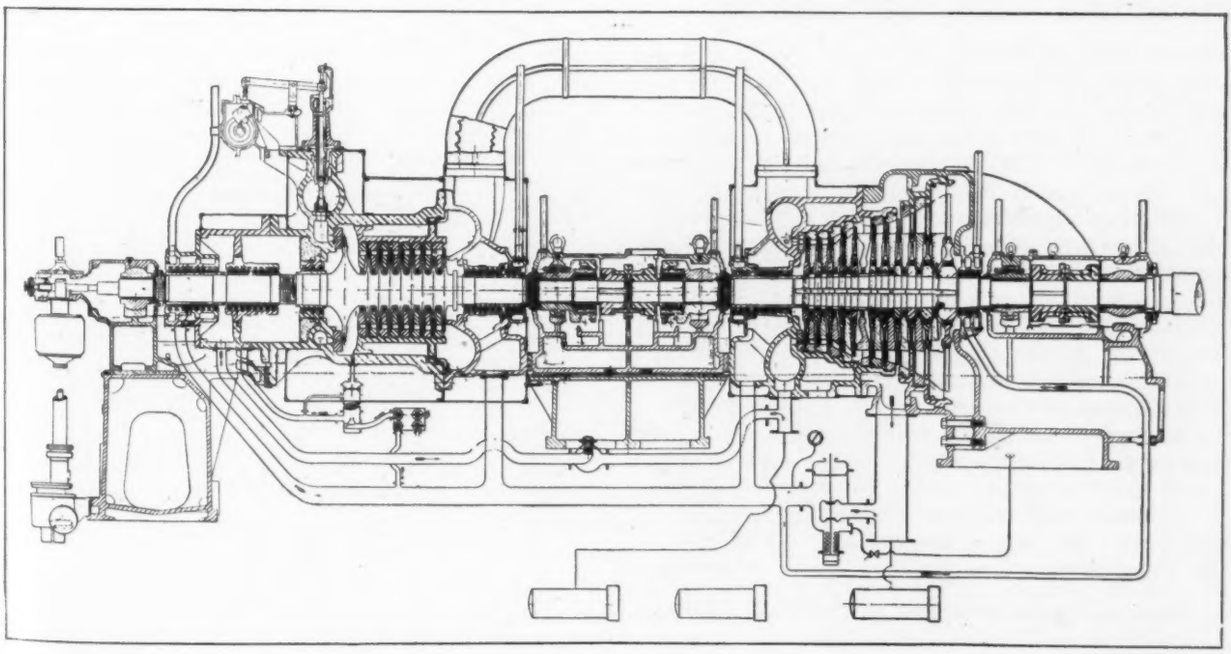
The generator has a capacity of 12,500 kva. at 0.80 per cent power factor, 60 cycles, 3,600 r.p.m. Energy is delivered at 4,800 volts without transformation into the distribution system. A fin-tube type air cooler which receives its cooling water supply from the condenser circulating pump cools the air in the closed air circuit. Direct-connected excitation has been provided, including main and pilot exciters on the generator shaft.

The auxiliaries that have been provided with the turbo-generator are identical with those that are in use with the 4,000-kw. direct-current house service machines installed at the Delray and Trenton Channel power houses. Slightly more surface, however, was added to the condenser to meet the increased steam-condensing requirements, and a separate boiler feed pump was provided.

The Babcock & Wilcox superheater, which is described more in detail elsewhere in the technical press, contains approximately 4,000 sq.ft. of heating surface and is designed to raise the temperature of 90,000 lb. of steam per hour from 700 deg. F. to 1,100 deg. F. Heat is

High temperature requires special turbine design

Three particular features are apparent in this cross-section of the turbine. These are (1) the extraordinary amount of shaft packing at the entrance end of the high-pressure cylinder, (2) the large first-stage wheel by means of which the highest temperature is largely retained at the entrance end of the cylinder and (3) the double casing of the high-pressure section, the inner casing being of the usual split and bolted type, while the outer is an integral cylinder.



supplied by three mechanical atomizing type oil burners which use No. 6 bunker fuel oil. The superheater is composed of three sections—the top convection section, made from low carbon steel, which will receive steam at 700 deg. and raise the temperature to 850 deg.; the middle combined radiant and convection alloy steel section, which will raise the temperature to 1,030 deg., and the lower radiant alloy steel section, which will increase the temperature to 1,100 deg. at the outlet.

A solenoid-operated valve of the safety valve type has been provided at the superheater outlet. This valve will open automatically whenever the turbine throttle valve is tripped. The steam thus relieved to atmosphere will serve to maintain a circulation of steam through the tubes of the superheater, thereby preventing overheating due to the heat stored in the setting. If at any time the relief valve is opened by tripping the turbine throttle valve the fuel oil pump motors will be automatically cut out, thereby stopping further addition of heat to the furnace. The motor-operated inlet valve to the superheater is also interlocked with the fuel oil pump motors. In the event it is ever necessary to close this inlet valve by remote control to protect life or important operating equipment the supply of oil to the burners will be automatically stopped.

Steam is led from the outlet of the superheater to the turbine through an 8-in. steam line made from KA2S tubing.† Stresses in this line were kept as low as possible in order to keep within the allowable thrust of 2,000 lb. on the throttle valve flange, as permitted by the turbine manufacturers. A number of different types of pipe joints have been installed in this line in order to obtain as much information as possible regarding their behavior when subjected to high temperature. Three different alloy steels, not of the 18 Cr-8 Ni type, have been used in various fittings in order to collect data on the suitability of lower-priced materials.

▼

Commission Makes Comparative Residential Rate Tabulation

Connecticut's 169 towns are served by 33 different private and municipal electric utilities and there are altogether 107 rate schedules applicable to domestic use. In response to a comment in the inaugural address of Governor Cross the Public Utilities Commission undertook to digest these rates so that they could be compared with one another in a simple manner. In the tabulation acompanying the report to the Governor the minimum bill, components of flat charges, minimum house areas and the kilowatt-hours in each block are set up for each of the rates. Next the bill for various amounts of energy per month (0, 20, 40, 60, 100, 200, 300, 500 kw.-hr.) was placed in conjunction with the charge for a minimum-sized house and others of 2,000 and 4,000 sq.ft.

The result is in such form that any consumer can see the elements of his own charges and can compare his bills with those of comparable users in other territory or of customers with different use characteristics in his own territory. In spite of the detail of the breakdown it was found necessary to insert 35 notes to interpret features to which the tabulation did not lend itself directly.

Messrs. Rudd and R. G. Warner of the commission staff are continuing the study into commercial and power rates. In the report to the Governor it was stated that even more difficulty would probably be encountered in the effort to reduce those schedules to a similar parallel set-up.

▼

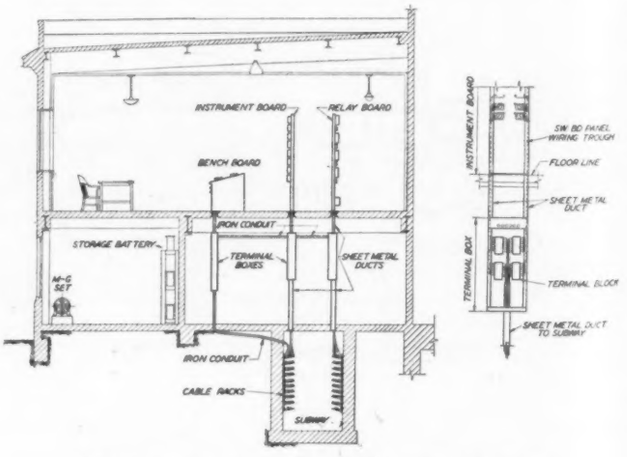
Condensed Switch and Terminal Board Reduce Building Cost

Over-all length of switchboard was kept to a minimum and building cost reduced at the Newark substation of the Pacific Gas & Electric Company by mounting all relays on a separate board from the 30x100-in. panel used for indicating instruments and for four-line circuits. To facilitate the connecting and testing of the resulting large number of cables, terminal blocks mounted in sheet-metal boxes were installed directly below each panel as shown by the accompanying drawings.

The switchboard panels were built and wired by the manufacturer and all wires were left extending 5 ft. below the panels through a square hole in each bottom corner. When the panels were installed these wires were run through sheet-metal ducts to the terminal blocks below. Since each wire was tagged and long enough to reach the proper terminal, which also was numbered, very little time or labor was required to make connections. All wiring between panels, such as control and synchronizing buses, etc., was done in the terminal boxes.

From the bottom of each terminal box either several iron conduits or a 4x6-in. metal trough connect to a subway underneath where racks are provided to carry the cable. Control wire from every piece of equipment passes through this subway to its proper terminal box. The lead sheathing of control cable from outdoor equipment terminates in the terminal boxes.

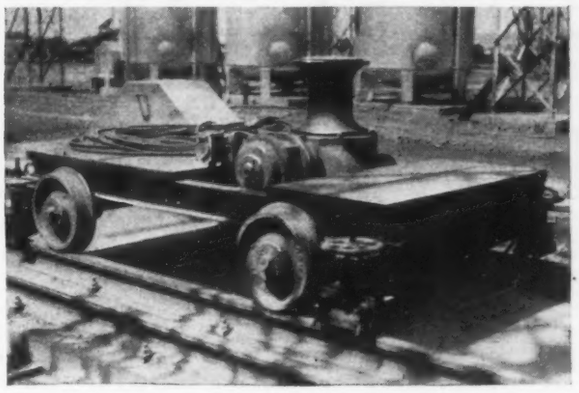
By this system of terminal boxes and subway new circuits may easily be added and all testing and fault tracing can be done without disturbing the operators in the control room.



Space was conserved in this control room

†*See "Piping for 1,000-Deg. Steam," by J. H. Walker in "Heating, Piping and Air Conditioning," April, 1931.*

Car-Mounted Winch Moves Heavy Substation Equipment



Vertical car-mounted winch saves time in handling heavy equipment

As a means for moving the 18,000-kva. transformers and other pieces of equipment in one of its substation yards, the Pacific Gas & Electric Company of San Francisco developed the car spotter shown in the accompanying illustration. Not only has this been used to good advantage during construction, but it will also be used for maintenance work after the station has been completed. The equipment consists of an electrically operated vertical winch mounted on a special low-bed car equipped with standard-gage railroad wheels. Rail-clamping devices at each corner of the car firmly hold it to the rails while pulls are being made. Necessary power outlets are provided in the substation yard, and sufficient connecting cable is carried on the car. The winch was manufactured by the Sprague Electric Company and is of 5,000-lb. capacity.

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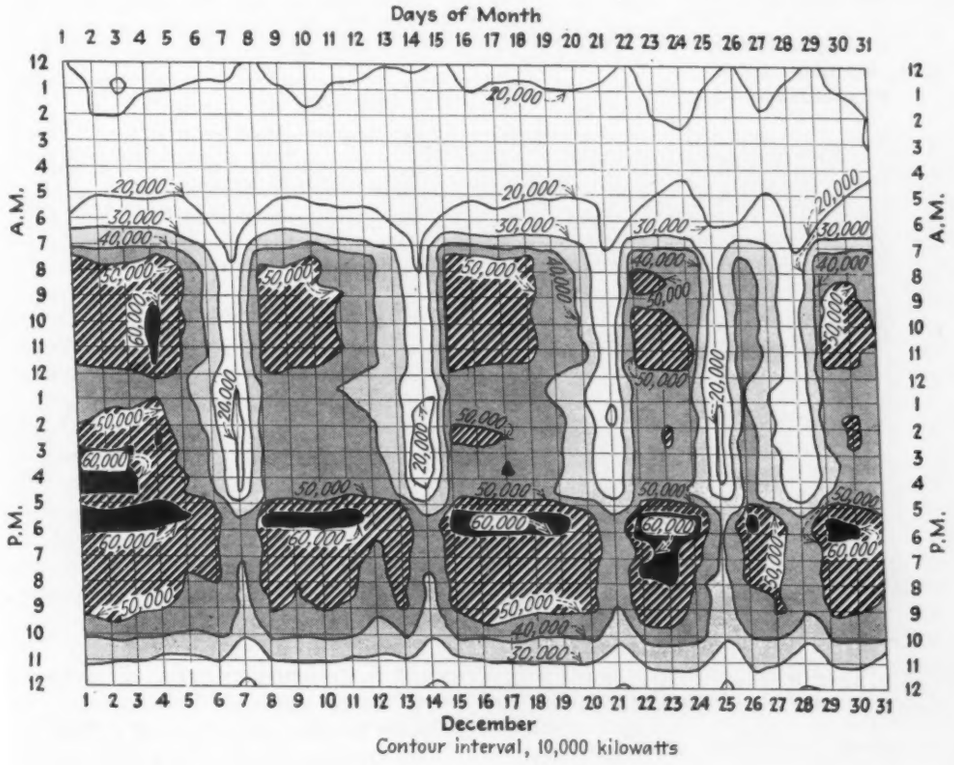
Contour Map Facilitates System Load Study

By WALTER H. PROESCHOLDT
Iowa Railway & Light Corporation, Cedar Rapids

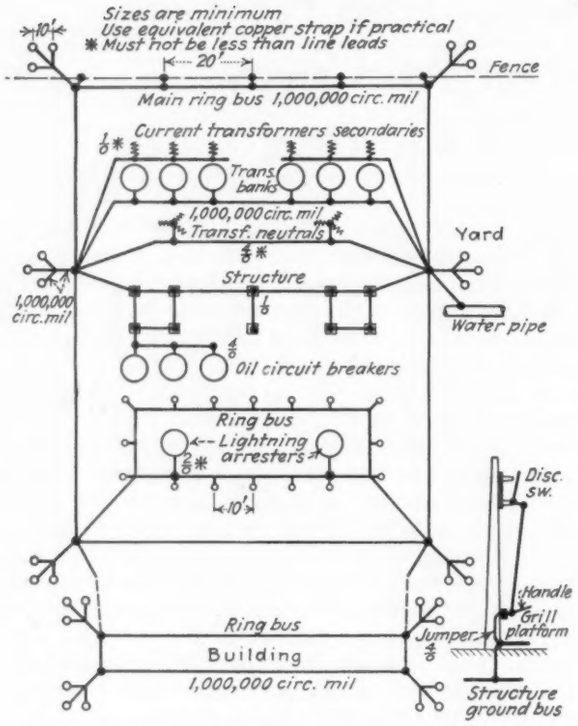
Trends and characteristics of system load are frequently represented, for convenience in studying them, by three dimensional graphs consisting of daily load profiles laid flat on each other in daily sequence. The results are spatial graphs in which the horizontal plane ordinates are days and hours of the day and the vertical ordinate is system load. Due to the thinness of the paper or cardboard from which the daily load profiles are cut, the ordinate of days in such an assembly is very short compared with the two others and for this reason the stack is difficult to use. This difficulty is usually avoided by spacing the profiles a fixed distance apart on a frame of some kind, giving the graph the appearance of a skeleton relief map. However, this three-dimensional graph is cumbersome, awkward to study and requires careful handling to avoid damage to it.

The same information, in a form more convenient to handle, easier to study and from which copies may readily be made, can be presented in two dimensions as a contour map of the relief graph. This contour map may be constructed from the relief map or it may be drawn direct from the daily load curves without the intervening step of building the relief graph. By the latter method the points selected for load contour levels are spotted on the hours of their occurrence for each daily load on the Y-axis line, which indicates the particular day. Areas are then inclosed by lines connecting points of equal elevation. The value of the contour map is apparent. For instance, daily system load conditions for a year can be represented on twelve sheets of paper, one for each month, whereas the same data presented in three dimensions in spatial graphs would require twelve bulky assemblies of spacing frames, each supporting from 28 to 31 profiles.



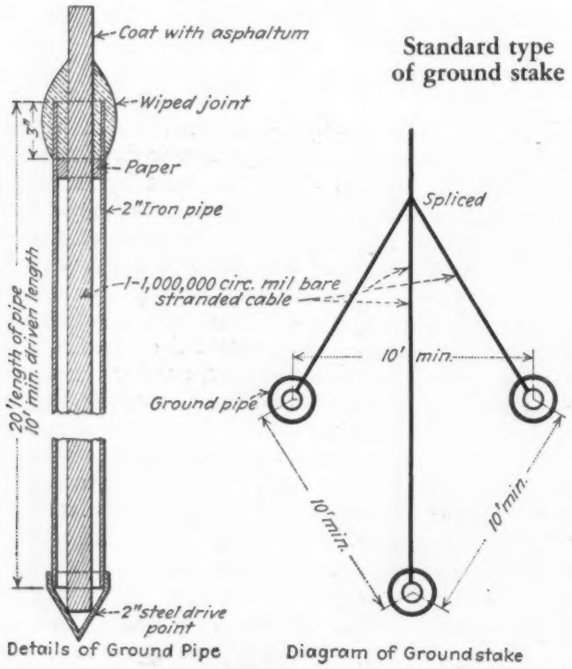
System studies are helped by contour load map

Ring Ground Bus System Is a Feature of Boston Edison Stations



Ring-type station ground buses

Loops serve different classes of equipment and multiple connections with the sub and main rings, insure continuous paths for fault currents to earth and prevent accumulation of abnormal voltages through "backing up."



Standard type of ground stake

By inclosing stranded cable by iron pipe with a steel drive point at the bottom and wiped joint at the top rusting troubles are minimized and the integrity of grounds long maintained.

TO EQUALIZE ground potentials and provide complete protection for operators under all anticipated conditions in and about generating plants and substations the Edison Electric Illuminating Company of Boston's station engineering department has designed a conventional grounding system of the ring type, applicable to a wide range of installations and comprehensive in its co-ordination of grounding facilities for different classes of equipment and structures. One of the best examples of its application occurs at the Woburn substation, where two incoming 110-kv. circuits from the New England Power Association system interconnected with the Edison company's system, with its 14-kv. feeders and tie lines serving the metropolitan and suburban areas from tidewater steam plants.

A main-ring ground bus surrounds the station and yard, with 1,000,000-circ.mil copper used throughout. Associated sub-buses of smaller size serve transformer tanks, neutrals and current-transformer secondaries, switch and insulator supporting structures, oil circuit breakers and lightning arresters. Sub-buses are connected to the main bus by at least two paths. Each switchboard has the usual ground bus, to which are connected panel frames, instrument and relay coils, neutrals of all secondary circuits, etc. Each floor, line or row of apparatus has its own sub-bus. A separate ring bus is provided for lightning arresters; metal fences which may be subjected to undue voltage exposure are connected every 20 ft. to the ground bus, and separate buses are run for each type of neutrals. A direct tie is run between the neutrals of apparatus normally operating together. Operating positions which may become dangerous are shunted by one or more ground leads. The operating mechanism of an outdoor disconnecting switch, for example, is provided with a jumper from a point several feet above the handle to the platform and then to the ground bus or sub-bus. A removable operating handle of insulating material is used.

Capacity of ground buses

In general, any ground bus, lead or connection is required to be able to carry full fault current for at least one minute. Most ground faults will develop into a three-phase fault within 30 seconds or the relay protective scheme will have operated. The resistance is specified to be such that the maximum fault current will not produce more than 50 volts drop between any points. Normally, ground connections must equal or exceed the size of the associate power conductors. Copper strap is used wherever possible as its joints may be bolted or, preferably, brazed; connections to apparatus may be cable (not wire) and are flexible to allow for settling.

The main ring bus is designed to carry the ground-fault current of the entire station. This varies from two and one-half times the three-phase fault current of one generator to one and one-tenth times that of ten

units operating in parallel. For installations with neutral resistors this reduces to a direct calculation of

$$\text{circ.mils} = 10.5I\sqrt{S},$$

where I is ground current and S is seconds of flow.

Ground connections to generators, motors, condensers and lightning arresters equal the line leads and are not less than No. 2/0. All lead cable sheaths are grounded. Power transformer cases have ground connections equal to the main ground bus.

Ground connections to oil circuit breakers are required to be able to carry one-quarter the breaker rating but are not allowed to be less than No. 4/0 or larger than the breaker leads.

Outdoor current and potential transformer cases, "disconnects," insulator bases, regulators, etc., have connections equal to line leads and not less than No. 1/0. Indoor transformers have No. 4 connections; current and potential transformer secondaries use No. 6 building steel and each leg of outdoor structure at least No. 1/0, and the operating mechanism for disconnects has jumpers equal to No. 4/0.

Overhead-line ground wires are brought down the tower to the ring.

Separate leads to the ring ground bus are installed for neutrals of different voltages, lightning arresters, instrument secondary circuits and equipment, in order to prevent dangerous voltages "backing up."

All grounding connections are run by the shortest practical route and are either exposed or in non-metallic conduit.

Grounding connections to apparatus neutrals equal the machine leads.

Earthing practice

Main ring buses have a ground rod every 15 ft. or groups of three at each corner. The lightning-arrester ring bus has rods 10 ft. apart.

In general, as the ground resistance is within 6 ft. of the rod, rods are not spaced less than this.

Sufficient links are provided to permit checking ground-stake resistances.

The total substation ground resistance is not allowed to exceed 5 ohms, or 1 ohm for a generating station, and each ground rod is assumed to carry 2,000 amp. to 3,000 amp.

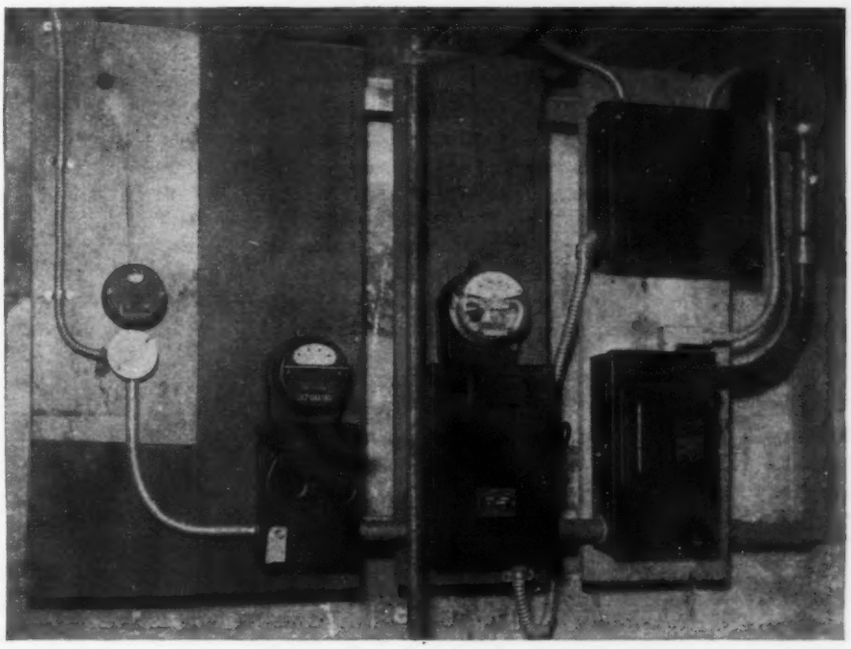
The main ring bus is connected to the water-piping system to prevent dangerous voltages produced by fault currents coming in over the water pipes, and trenches for leads, connections, etc., are not allowed to be less than 18 in. deep.

Metal-Clad Metering Specified for Rural Service

In some of the better types of rural service a trend toward metal-clad switch boxes and meter trims comparable to industrial practice is apparent. A representative installation shown herewith serves a rural customer operating ten electric brooders of 440 watts each, an 8-kw. electric range and a 2-kw. off-peak water heater besides the usual residential lighting and minor home applications. The service enters the building through a 1¼-in. rigid conduit which is curved at the lower end to save the cost of an elbow. The service is brought into an entrance box containing a 100-amp. switch with fuses and solid neutral. From here it is carried to a meter switch box with 60-amp. switch, and from the meter box to a cut-out box controlling all service on the premises except water heating. A 30-amp. meter and a time clock governing the period of charging the water heater are mounted in close proximity, the heater being supplied by two No. 12 conductors carried in flexible metallic conduit. All switch boxes and meters are mounted on vertically set meter boards to eliminate warping often experienced with horizontal panels.

There has been some discussion as to the desirability of doing away with the entrance-switch cabinet and depending on the switches in the two metering cabinets instead. In some communities served by the company the former can be omitted without objection from the inspection departments. With this item out, the remainder illustrate a type of construction and assembly which some utility men believe will find use on important farm installations with varied services, comparable to small industrial establishments in the importance of their central-station needs.

Metal-clad metering and switch facilities minimize rural fire and accident hazards



Rocks Ahead*

The best way to avoid them is to determine their position accurately, chart a course that will clear them, and then forget the rocks and think exclusively about the course chosen.

By Prof. PHILIP CABOT

School of Business Administration, Harvard University

THE worst obstruction that I see ahead is the growing agitation against what is called the "power trust." It has been visible for several years, but as we approach the next Presidential election, with two possible candidates already trying to run you onto this reef, to say nothing of other prominent politicians long headed in that direction, the time has come when it seems to me that the exact character and location of this obstruction should be determined. It is perhaps needless to say that politicians are rarely expert navigators, and those who at the present time seem most eager to chart your course for you and take the wheel seem to me mere star gazers whose theories of navigation in this field of industry are quite untrustworthy. They do not know *what* the obstruction is, *where* it is, or how to avoid it, and I am by no means sure that they care, for much that they say makes me suspect that they would be glad to see you strike a ledge and go to pieces on it. If this is the case the need for expert navigation is all the more urgent because the fog produced by these gentlemen makes the visibility low.

The chief objects of the present attacks on the power industry are the holding companies, which have grown up in this field like mushrooms after a rain and which the politicians group under the general stigma of the "power trust." Much breath and ink have been wasted in the attempt to prove that the "power trust" is a myth. I say wasted advisedly, because while we all know that there is no such thing, and that it wouldn't make any difference if there were, the attacks on it go on unabated.

For this there are two reasons: First, the experience of politicians that an ignorant and gullible electorate can always be frightened by a bogeyman, provided he is big enough and is kept constantly in the public eye. The voters of the nation have not yet realized the magnitude of the home market or the necessity for great units of production and distribution to handle the business. Although big units are growing up in every field to meet this necessity, people are still afraid of mere size and will probably continue to be so for years to come. To educate them out of this error is one of the most crying needs of our time.

Many sober-minded people suspect that the holding companies, though useful in themselves if scrupulously managed, are often used as a cloak to conceal promoters' and speculators' profits which are unwarranted and vicious. The atmosphere of secrecy which surrounds many of the financial operations of the holding companies, and their unwillingness to draw aside the veil, may well have led the public greatly to exaggerate the magnitude of these profits. Promoters are human and therefore vain. Like the rest of us, they boast of their successes and conceal their failures, and the cloak of secrecy which has been drawn around many of their most important operations has created a hotbed of suspicion which the politicians are vigorously trying to fan into flame.

In position of railroads 30 years ago

The present position of the electric power industry resembles the position of the railroads 30 years ago in the fact that with the end of the promotion period in sight a new type of leadership is required, and if the investors who have put billions into the business expect to escape the fate of investors in the railroads, the time for action is here. The agitation for more rigid regulation which is springing up in various parts of the country should be a warning to them.

Let them dismiss the hope that the politicians of our time will be more statesmanlike than their predecessors. That hope is futile and in fact foolish. It is not their business. If the change is to be made it must be made by the industry itself. Self-regulation, not government regulation, is what the industry needs, and if the men who now dominate this industry have not the wisdom and foresight to take the necessary measures they will have no right to complain if they see it bedeviled by politicians and demagogues.

**Excerpts from address before Bedford Springs convention, Pennsylvania Electric Association.*

The attacks on the holding companies now being made by aspirants for political office may not come to anything, but they are ominous. Suspicion is being planted in the public mind, and no man can tell when the discovery of some questionable promotion may cause it to burst into flame. The only safe course for the leaders of the industry is to lay all the cards upon the table and use the most scrupulous care to make sure that the public is completely informed. There is no adequate reason for concealment, even of what is past. Let the managers of the holding companies say to the Federal Trade Commission which is investigating them: "This is what we have done. Like other men we have made mistakes and perhaps done what we would not do again. But please remember we were sailing an uncharted sea, the dangers of which were great. Like all pioneers, we had to act hastily on insufficient knowledge. Looked at as a whole, we are proud of our work. Here is our record and we stand upon it."

Complete frankness is your best protection, and if the transactions continue to be obscured by fog, there is grave danger that the ship will strike on the ledges which railroads encountered in their development period. The voters are now ignorant and always gullible and to allow the politicians to go on sowing suspicion in their minds is hazardous. If there is nothing to conceal, why conceal it; if there is, better confess it now.

Requirements of leaders changed

The problem which now confronts the owners of the properties, namely, to find the right type of leaders, is difficult, but not impossible. The industry has reached a stage in its evolution where leaders with a different mental focus are required, single-minded men who think and plan for the future of the industry and not for themselves. For such work the promoter is ill fitted because he stands in his own light; the very qualities which made him succeed now blind him. He cannot see clearly because he sees double. No man can serve two masters, his own private interest and the interest of those he serves. The promoter's profit, necessary as it was in the promotion stage, now clouds his vision so that he cannot see the future. Having done its work it must now be removed, and the promoter should go too.

The only men who can now lead the industry to success are men who will work for wages and whose sole profit or reward is in the satisfaction of seeing the work well done. They are men of the professional type, but animated by the keen curiosity of the scientist. The desire for planned progress, which we call evolution, must be their dominant motive, for there is grave danger that when an industry of this type passes from the promotion to the marketing stage, initiative and alertness will vanish with the promoter and the industry will fall into stagnation under the dead hand of bureaucracy. Government regulation seems to have started the railroads along that road, but the power industry need not follow. There are plenty of problems of intense interest in the field of electric power if only the men in command can see them. It all depends upon the point of view. In its earliest stage it was right that the profit motive should be dominant, but now the professional motive must take its place.

The promotion stage is the heaven of the creative builder, in which problems of construction and operating efficiency predominate, and the attention of management is then focused on costs, because these are the variables which it is easiest to control. The market is allowed to take care of itself because the demand is urgent. But eventually the time arrives when costs begin to get rigid, and then the manager must turn to the development of the market. The time when costs become rigid and demand remains flexible marks the end of the promotion stage, at which the domination of the engineer must cease, for in the development of markets a different type of man is needed. The emphasis has shifted from costs to prices.

At this stage the interests of the customers, the investors and the public merge, and the type of leader required for success is the scientific industrial philosopher, a professional man whose dominant motive is not private profit, but the service of mankind. For him profit is the score, but not the game; the game is to develop the maximum volume of profitable business in his field, and from this nothing will divert him. He will turn a deaf ear to lawyers and engineers who urge him to limit the market by fixing his rates according to some formula based on his legal rights or his alleged costs, and also to politicians who urge him to favor one class of customers (the domestic) at the expense of another class (the industrial). He is bent on developing the whole market and will not stop until that is done.

In this stage the builder, the engineer and the promoter cease to dominate, the promoter being completely eliminated and the engineer being absorbed into a close-knit organization, or team, in which each group plays its own part, with full knowledge of what the other players are doing. The team has a captain, but no star players, for stars, as we know in football, tend to destroy the integrity and cohesion of the whole.

There will probably be some who think it impossible for the electric power industry to make such a radical change in the character of its leading executives because able men actuated by such motives cannot be found. That they are rare no one will deny, but examples of this type can be found on the executive and research staffs of many great industries. The demand will create the supply. The present plight of the railroads seems to be due to the fact that they did not demand them, because the directors failed to understand the change that had occurred, or, if they understood it, refused to take the necessary action so that the public, which sensed the change, was forced to deal with the problem through the cumbersome machinery which democracy provides.

Perhaps we can hardly blame the railroad men for this failure. It was their misfortune rather than their fault. The situation presented a new problem in industrial democracy which only genius could grasp, and the genius was lacking. But if a similar situation occurs again we ought to know how to deal with it. The first failure may have been a misfortune, but a second failure will be somebody's fault.

To meet these attacks chart a course which you are convinced will accomplish the result at which you aim, namely, the complete development of the field which has been assigned to you. Make sure that your organizations from top to bottom understand where you are headed, and then forget the attacks and put your whole heart into your work.

Wiring Telegraph Building for Continuous Power Supply

Continuous power supply to the new twelve-story building of the Western Union Telegraph Company at Boston was the essential requirement in the electrical design of this important communication center. Small as is the chance of an interruption of the incoming service of the Edison Electric Illuminating Company's alternating-current feeders and 120-208-volt associated future network, the Western Union company has provided against this by installing two 125-kva. alternators for emergency use under gasoline-engine drive. Each of these sets is started by a motor energized from a storage battery. The flexibility and reliability of this arrangement are featured in the accompanying diagram.

Normal service is furnished by two 13.8-kv. alternating-current Edison feeders, each rated at 450 kva., which is the maximum building demand. Each feeder energizes a three-phase, 450-kva., oil-filled, self-cooled transformer, the primaries being connected in delta and the secondaries in Y, with grounded neutral. This furnishes a duplicate secondary four-wire distribution system at 208 volts between phases and 120 volts between any phase conductor and ground.

The emergency generators are designed to deliver the same voltages as the secondary network system, but will not be operated simultaneously with the incoming power. Each emergency unit is started by a 12-volt, direct-current, series-wound motor served by three storage batteries. These batteries are connected through a relay for automatic supply of energy to a limited number of emergency lights in case of failure of the normal supply system and during the period of starting the emergency units. The batteries are automatically charged by a rectifier which is fed by alternating current from an emergency lighting cabinet.

As a further measure to insure continuity of telegraphic power, provision is made to cut out the building telegraph units and tie the circuits directly with the outside telegraph network in case of breakdown of all sources of supply to the building.

Energy for building service, lighting and telegraph power circuits is distributed from a main switchboard in the basement, which is of the live-front type, consisting of fourteen panels. Two of these control the emergency alternators, four panels are assigned to feeders for motor-generators and blowers used in connection with telegraph circuits, one panel controls two 50-hp. compressors, two panels are assigned to lighting, two panels furnish building service power, two control the incoming Edison power and one is left as a spare. Breakers and switches on the main switchboard are of the three-pole type, the fourth lead being connected directly to the ground bus. This bus is made up of one 2x¼-in. copper bar, which is tied to fifteen grounding stakes connected by a 1½x¼-in. copper bar.

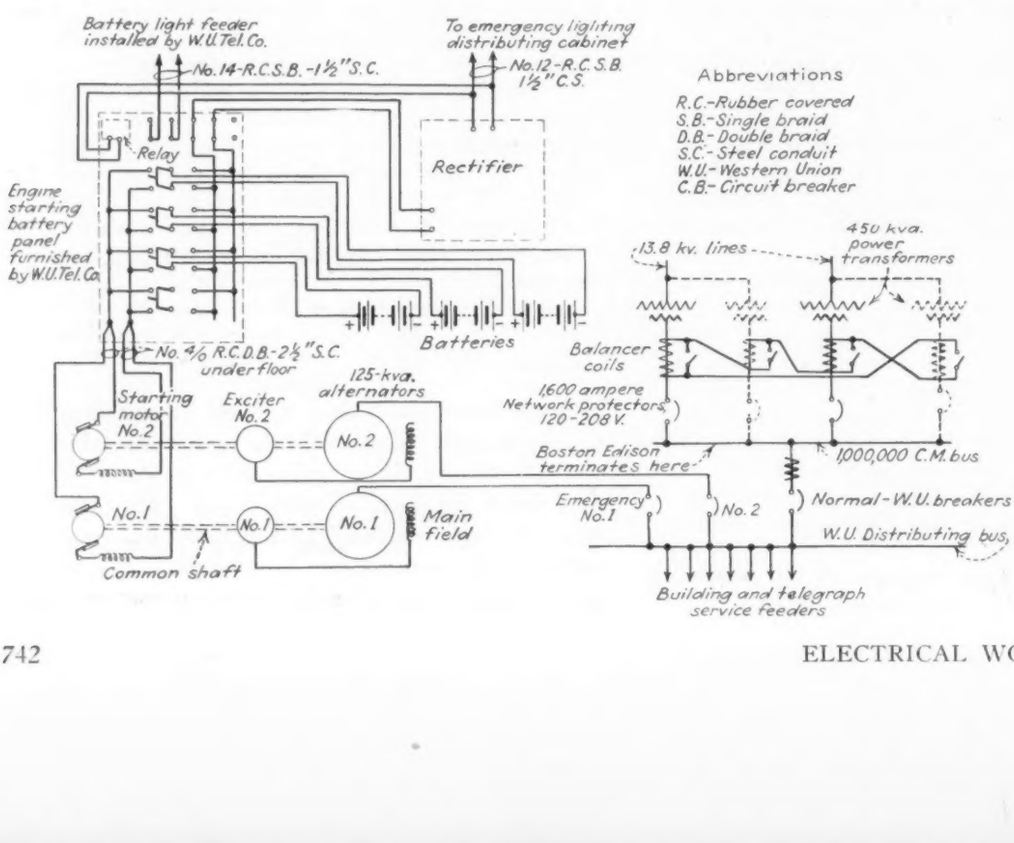
Building service branches are distributed through live-front insulating panels inclosed in steel cabinets. Lighting circuits are distributed from dead-front interchangeable-unit cabinets containing a four-wire, three-phase, 120-volt bus and two-wire, single-phase branch circuits with the phases balanced in each cabinet.

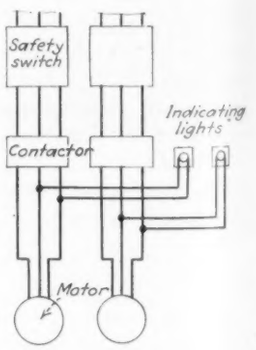
Branch wiring for lighting, telephone and signals are carried in underground duct placed in the cinder fill between the structural slab and finish. Flexibility of wiring is provided by building this duct into a network spaced 24 in. apart and placing the duct inserts on 24-in. centers. Location of these inserts is indicated by small markers at the two end points on each run.

Telegraph power is distributed from a five-panel switchboard located in the dynamo room on the seventh floor, which houses the telegraph motor-generator units. These units include three 20-kw. motor-generator sets delivering direct current at 110 volts, six 2-kw. sets

Purchased power supplemented by emergency reserve

Normal operation of telegraph power service is by purchased energy, with engine-driven alternators held in reserve with motor starting from a storage battery installation.





Neon pilot lamps furnish remote indication of motor-driven equipment in operation

delivering d.c. at 160 volts, five 2-kw. sets generating d.c. at 240 volts, two 3-kw. units for 24-volt d.c. circuits and twelve all-metallic units (two-wire no-grounded brushes), each rated at 500 watts, 160 volts d.c.

Building service feeders include risers for unit heaters and feeders for elevators, ventilating fans, pumps, water cooling and circulating equipment. Building service circuits are each connected to motors through safety switches and magnetic contactors with thermal overload relays and remote control. The location of most of these motors and of the elevator motors in the penthouse required an indicating device in the superintendent's office on the first floor, showing which of these machines is in operation. A simple and dependable indicating panel was provided by a 12x18-in. bakelite board framed in a steel box 4 in. deep and fitted with indicating lamps, as shown in the accompanying illustration. This panel is set flush with the wall and is provided with holes for standard-base neon glow-lamps, each rated at ½ watt when supplied at 208 volts. These lamps are connected across the load side of each motor contactor and glow when the corresponding machines are started. Nameplates identify the circuits.

The Stone & Webster Engineering Corporation was engineer and contractor for this building.

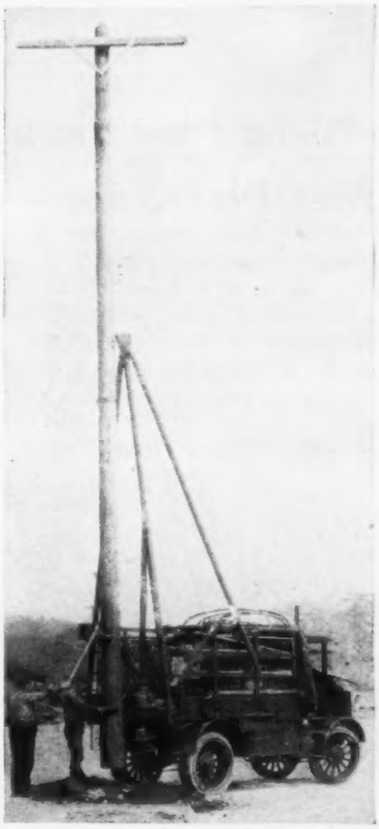
▼

Drag Scraper Permits Economical Yard Grading

In grading the area to be used for coal storage at the South Amboy station of the Jersey Central Power & Light Company use was made of the permanently installed equipment for coal handling. By attaching several rails by chains to the drag-scraper block and pulling them crosswise back and forth across the area to be leveled a most satisfactory result was obtained at low cost.

This expedient, it is said, reduced the man power needed for grading purposes to one-twelfth of that which would have been required had conventional methods been used.

Truck-Mounted Auger-Derrick Sets 6 to 10 Poles an Hour



Prior to May, 1924, a central-station company set all poles by the use of pike poles after digging the hole by hand.

At the time mentioned above a line crew was organized for the purpose of setting poles with a truck on which was mounted a pole-raising derrick. Although there was a considerable saving in time and labor by this method of operation, this was due mostly to organization and to specializing in this one activity.

The actual saving made in time and labor by the use of the derrick in so far as the various operations were concerned was in the time that was required to set the pole, a net saving of approximately five minutes per pole.

Since the major operation consists of digging the hole, a slow process by manual labor, the next step was to procure an earth-boring machine. The equipment available, however, up to 1925 was cumbersome and was mounted on a truck which could be used for no other purpose. Since then the company has purchased a combination earth-boring and pole-setting machine mounted on a standard line construction truck. Labor and trucking by this method of erecting poles is less than one-third of that required by manual labor. In addition, the possibility of accidents has been reduced to a minimum.

Briefly, the construction and the operation of this apparatus are as follows:

The earth borer, which consists of an auger attached to a shaft and its operating mechanism, is installed at the rear of the truck on the right. Power for operation is supplied by mechanical connection to the engine of the truck under the control of the chauffeur. The operation of the earth borer is accomplished by means of two levers at the rear of the truck, one controlling the drive and the other the feed. The hole is dug to an average depth of 6 ft.

While this operation is in progress the end of a steel cable is secured around the pole. This steel cable ex-

tends over the top of a derrick at the rear of the truck to a winch at the back of the chauffeur's seat. The chauffeur, by means of a lever, places the winch in operation and by so doing raises the pole and then lowers it into the hole while it is guided into place.

The crew required to execute the work as outlined consists of a chauffeur and two helpers. The number of poles placed varies from six to ten per hour.

▼

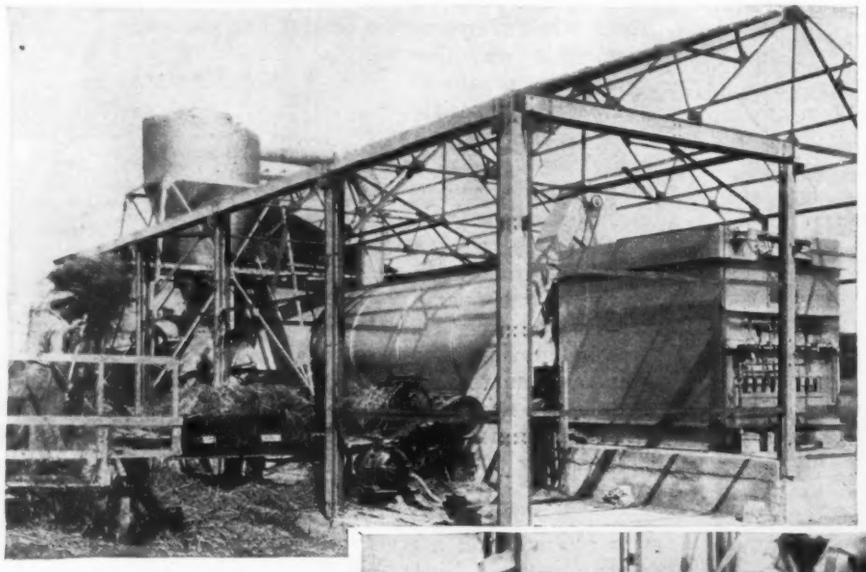
Making Hay Though the Sun Does Not Shine

What is said to be the first hay drier in New York State has been installed on the 700-acre dairy farm of E. B. Ashton, near Saratoga, and is now in operation. Green hay is brought directly from the fields, run through a chopper, cutting it into lengths of about $\frac{1}{8}$ in., and is then passed through a rotary cylinder where the moisture is removed by heated gases. The dried hay is then blown into the mow or storage bin or may even be packed in bags for storage or shipment.

The chief advantage of curing hay artificially is reported to lie in the higher food value produced through an increase of protein content, an increase of digestible carbohydrates, an improved flavor and aroma and a sevenfold increase of vitamin A content. In addition to this increased feeding value, there is a distinct advantage in not being dependent upon a whimsical sun for drying the hay, and the cutting process also makes for easier storage of the cured hay.

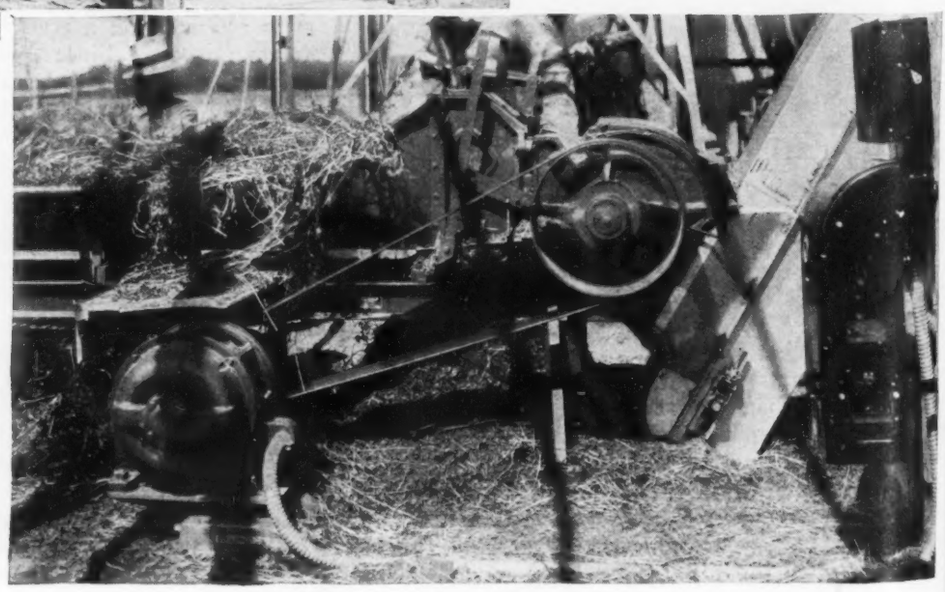
This installation, known as the Arnold "Ardrier," consists of three concentric revolving drums through which the green hay is rotated with hot gases (1,000–1,500 deg. F.) from an oil-burning furnace. The chopping machine is operated by a 20-hp. motor. The hay and hot gases are drawn through the three concentric cylinders by a large exhaust fan at the further end of the drier. The cylinders are rotated by a 25-hp. electric motor. The mixture rolls back through the first and second cylinders and finally passes through the largest one to the blower attachment, where it is sent to a separator, which permits the escape of the moisture-laden air and collects the dried hay ready for the mow or storage bin. The temperature at the outlet varies from 100 to 170 deg. The cylinder or revolving drum is 20 ft. long and about 7 ft. in diameter.

Because of the large investment which must be made, a large volume of hay is necessary to justify the purchase of a drier. On the other hand, because of the great economies involved, suggests A. N. Wood, head of the New York Power & Light Corporation, it may be that hay driers will be used in much the same way as the old threshing machines, which were taken from farm to farm after harvest time to prepare grain for market.



Hay drier used on New York farm

General Electric Company



Motor drive and convenient control for hay cutter

Determining Tie Line Losses

By H. ESTRADA and H. A. DRYAR
Superintendent of Station Economy and Chief Load Dispatcher, Respectively, Philadelphia Electric Company

The authors point out that tie line losses may have considerable effect on economical load allocation, and decisions for interchange of energy, and present a method of applying increment losses to these problems. Other applications of the increment loss are: Determination of reduction in line losses by use of synchronous condensers, comparison of locations for additional generating capacity, deciding effect of adding transmission lines and calculation of reactive kva. to carry in generating and synchronous condenser stations.

TRANSMISSION losses constitute an important factor in determining the most economical allocation of loads on generating stations and in deciding the price at which power shall be bought from or sold to interconnected companies.

One reason for their increasing significance on extensive power systems is that the generating stations are frequently connected by relatively long lines and the newer, more economical stations are frequently some distance from the load center. Even though loads are allocated for the most economical production costs, failure to consider the delivery costs may subject the operating company to very pronounced loss in system economy. While this loss in a system with heavily coppered transmission lines may amount to only a few per cent, yet this per cent loss is applicable to the total system generation cost, and may amount to a good many dollars in a year's operation. Any efforts to minimize this loss will, therefore, usually pay very good dividends.

Another reason for the increased significance of transmission losses is that purchases and sales of energy between interconnected systems usually change the loading of transmission lines in the individual systems. Not only will some of the lines be subjected to additional losses due to the increased load on these lines, but there will be instances where the load on other transmission lines will be reduced, and this gain or negative loss should be subtracted from the positive loss to arrive at the true loss in transmission. There may even be cases where the reduction in the losses of transmission lines will reach such a value as to make it economical to enter into a transaction for the sale or purchase of power, which would otherwise not be justified.

Hence accurate determination of tie line losses is required in individual systems to obtain the lowest cost per kilowatt-hour of the energy delivered to the distribution system, and in transactions between interconnected systems to determine if the transfer of energy is economical and enable the parties to the agreement to find the billing rate for the energy.

Methods of determining losses

Three methods of determining losses will be considered and their relative merits presented:

Average Line Loss (I^2R) Method—In many operating companies it is probable that even should losses in transmission be considered when scheduling the load to the generating stations the calculations are based on the average line loss. In following this practice they fail to consider that any increased loss on a transmission line due to the transfer of an additional block of power is the result of this added energy transfer and is chargeable only to this block.

For instance, assume that a 66-kv., three-phase line of 10.2 ohms resistance per wire is carrying a load of 20,000 kw. at 80 per cent power factor and it is proposed to increase the load on this line by an additional block of 10,000 kw. to 30,000 kw. at the same power factor. The total loss at 20,000 kw. would be: $\frac{3\,I^2R}{1{,}000}$

$= \frac{3 \times 219^2 \times 10.2}{1{,}000} = 1{,}465$ kw., and the per cent average loss $= \frac{1{,}465 \text{ kw.} \times 100}{20{,}000 \text{ kw.}} = 7.32$ per cent.

In the same manner, the total loss at 30,000 kw. would be: $\frac{3 \times 328^2 \times 10.2}{1{,}000} = 3{,}292$ kw., and the per cent loss $= \frac{3{,}292 \text{ kw.} \times 100}{30{,}000 \text{ kw.}} = 10.97$ per cent.

In dealing with the additional block of 10,000 kw., however, we are interested only in the additional loss incurred as a result of the increase in line loading from 20,000 kw. to 30,000 kw. It is probable that if the average line loss method of calculation were used, 10.97 per cent would be taken as the per cent loss applicable to the additional block of 10,000 kw. Actually, however, this loss is the difference between the total loss at 30,000 kw. load and 20,000 kw. load and amounts to 18.27 per cent

$= \frac{3{,}292 \text{ kw.} - 1{,}465 \text{ kw.} \times 100}{10{,}000 \text{ kw.}} = \frac{1{,}827 \text{ kw.} \times 100}{10{,}000 \text{ kw.}}$

If the average line loss method of calculation were used, this block of power might be given to a station of greater efficiency than that at the load center and the system economy would suffer a loss.

Watt-Hour Meter Method—When watt-hour meters are installed at each end of a transmission line it is the practice of some operating companies to regard the difference in the readings of these meters as an indication of the loss in transmission. This method is open to criticism for several reasons:

1. In an individual system the installation of the number of watt-hour meters and the necessary current and potential transformers required would be very expensive.
2. This method is but another way of arriving at the average line loss.
3. It would be difficult to determine in advance, with abnormal operating conditions, what the loss in transmission would be.
4. The transfer of a block of energy, superimposed on the normal line loading, would be attended with uncertainty as to the loss resulting from the transaction.
5. The sale or purchase of energy between interconnected systems may affect the loading of several of the tie lines of the transmission network of an individual system. It would be difficult to determine accurately, and especially so in advance of the transaction, what the losses would be. As the sale or purchase agreements between systems are made on relatively small differences in cost, there would exist much uncertainty as to the economy of many proposed transfers, with the result of limiting to a minimum the number of transactions.

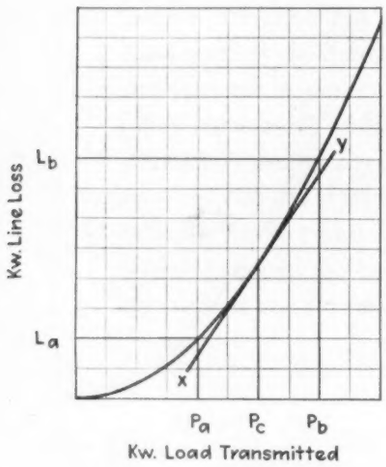


Fig. 1 — Per cent increment line loss is proportional to load

The per cent increment line loss at load Pc is the slope of line xy tangent to curve at Pc, the slope being expressed in per cent. Mathematically, it is the derivative of the loss with respect to the load. Since the loss varies as the square of the load (at unity power factor and constant voltage) the per cent increment line loss is directly proportional to the load.

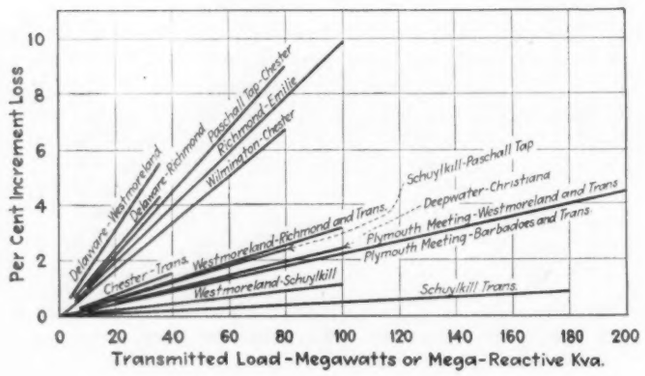


Fig. 2—Increment line losses for Philadelphia system

Incremental Method—In the operation of an individual system and the allocation of load to the generating stations of the system one is, in general, interested only in the additional or incremental losses incurred on transmission lines as a result of the transfer of a given block of load from one generating source to another. A very convenient method can be used for determining these incremental line losses. This method may be explained by reference to Fig. 1, which shows the kw. loss on a transmission line in relation to the kw. load transmitted at unity power factor, the loss varying as the square of the kw. load.

The increase in loss as a result of the increase in load from (P_a) to (P_b) is usually determined by subtracting the total loss for load (P_a) from the total loss for load (P_b). However, by using the per cent increment line loss, which may be defined as the ratio of the incremental increase in loss as a result of an incremental increase in load, to this incremental increase in load, it can be shown that the increase in loss resulting from an increase in load from (P_a) to (P_b) is equal to the per cent increment line loss at load (P_c) midway between (P_a) and (P_b) multiplied by the increase in load $(P_b - P_a)$.

If the increase in load $(P_b - P_a)$ is at unity power factor, the increase in loss will depend only on the kw. load transmitted on the transmission line and will be the same regardless of the power factor at which the line is operating.

The increment line loss of a three-phase balanced transmission line can be determined from the following formula:

Per cent increment line loss due to kw. transmitted $= 0.2\,R \times \frac{kw.}{kv.^2}$, where R = line resistance per wire in ohms, $kw.$ = total three-phase transmitted load, $kv.$ = line voltage in kilovolts.

In order to take care of loads at different power factors, a similar formula can be used to determine the increase in loss due to an increase in the reactive kva. transmitted, as follows:

Per cent increment line loss due to reactive kva. transmitted $= 0.2\,R \times \frac{rkva.}{kv.^2}$

The loss can be computed independently and added to that due to increased kw. loading.

These formulas may be derived as follows:

Let

R = Line resistance per wire in ohms.
I = Line current in amperes.
$kva.$ = Total three-phase transmitted kva.
$kw.$ = Total three-phase transmitted kw.
$rkva.$ = Total three-phase transmitted reactive kva.
$kv.$ = Line voltage in kilovolts.

$$kw.\ \text{loss} = \frac{3RI^2}{1{,}000}$$

But

$$I = \frac{kva.}{\sqrt{3}\ kv.}$$

Substituting

$$I^2 = \frac{(kva.)^2}{3(kv.)^2}$$

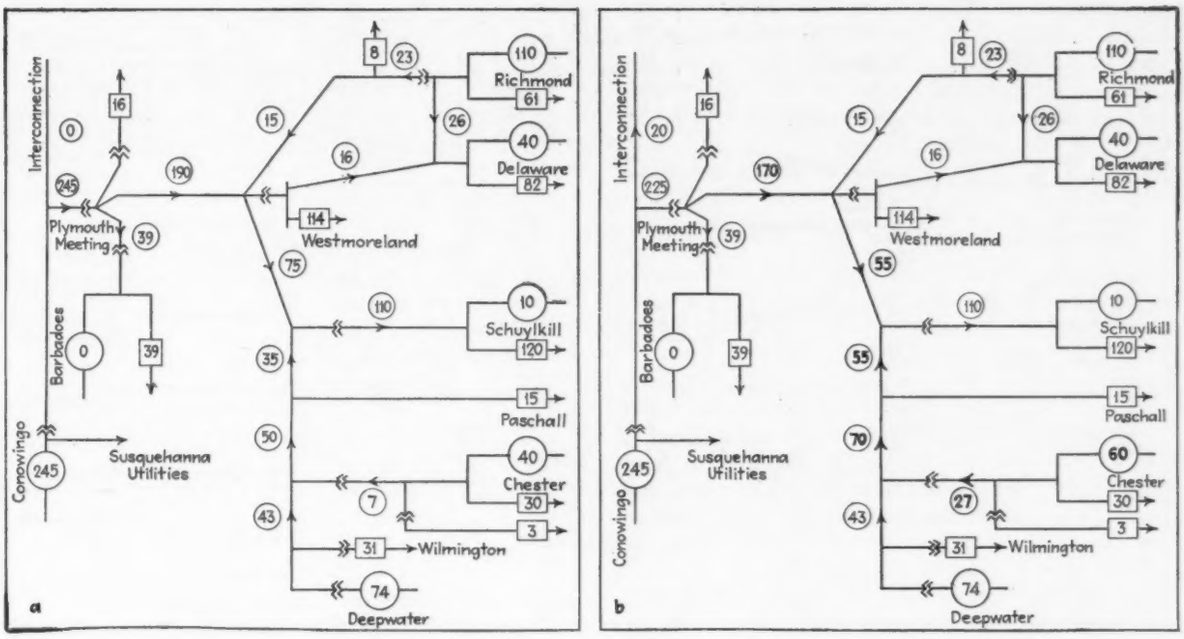
$$kw.\ \text{loss} = \frac{3R}{1{,}000} \times \frac{(kva.)^2}{3(kv.)^2}$$

Substituting

$$(kva.)^2 = (kw.)^2 + (rkva.)^2$$

$$kw.\ \text{loss} = \frac{R}{1{,}000\ (kv.)^2} \times [(kw.)^2 + (rkva.)^2]$$

$$= \frac{R}{1{,}000\ (kv.)^2}(kw.)^2 + \frac{R}{1{,}000\ (kv.)^2}(rkva.)^2$$



Figs. 3 a and b—System loading before and after 20,000-kw. transfer from Chester to Plymouth Meeting

Loads generated in each station are marked in circles, while the magnitude and direction of the line load are marked beside transmission lines. In Fig. 3b loadings are emphasized which are changed. Additional load is asumed to be unity power factor.

The kw. loss is, therefore, composed of two parts, one proportional to the square of the transmitted kw. and the other proportional to the square of the transmitted reactive kva. As the kw. transmitted is independent of the reactive kva. transmitted, each part can be differentiated separately to arrive at the per cent increment loss. Hence differentiating the first part, with respect to the kw. transmitted:

$$\frac{d\ (kw.\ loss)}{d\ (kw.)} = \frac{R}{1{,}000\ (kv.)^2}\ (2\ kw.)$$

Per cent increment loss due to transmitted kw.

$$= 100 \times \frac{d\ (kw.\ loss)}{d\ (kw.)} = \frac{R}{10\ (kv.)^2} \times 2\ kw.$$

$$= \frac{0.2\ R}{(kv.)^2} \times kw.$$

Differentiating the second part with respect to the transmitted reactive kva.:

$$\frac{d\ (kw.\ loss)}{d\ (rkva.)} = \frac{R}{1{,}000\ (kv.)^2} \times 2\ (rkva.)$$

Per cent increment loss due to transmitted reactive kva.

$$= 100\ \frac{d\ (kw.\ loss)}{d\ (rkva.)} = \frac{R}{10\ (kv.)^2} \times 2(rkva.).$$

$$= \frac{0.2\ R}{(kv.)^2} \times rkva.$$

The per cent increment loss due to the transmitted kw. is thus proportional to the transmitted kw. and the per cent increment loss due to the transmitted reactive kva. is thus proportional to the transmitted reactive kva. Also, both parts have the same constant of proportionality $\frac{0.2\ R}{(kv.)^2}$ and, therefore, a single per cent increment loss curve can be used for both parts conveniently.

Preparation of increment loss curves like Fig. 2 can be understood by considering the Plymouth Meeting-Westmoreland lines and the Plymouth Meeting transformers (Fig. 3a). There are three 66-kv. lines, each having a resistance of 1.22 ohms, and three 220 to 66-kv. transformers, each having a resistance referred to 66 kv. of 0.2 ohms. The resistance of the three lines in parallel is, therefore, 0.41 ohms, and of the three transformers in parallel•0.07 ohms. As the load on the three transformers at Plymouth Meeting is approximately the same as that on the three lines, the resistance of the transformers referred to 66 kv. can be conveniently added to the line resistance. This gives 0.48 ohms as the transformer and line resistance for the three lines and transformers in parallel.

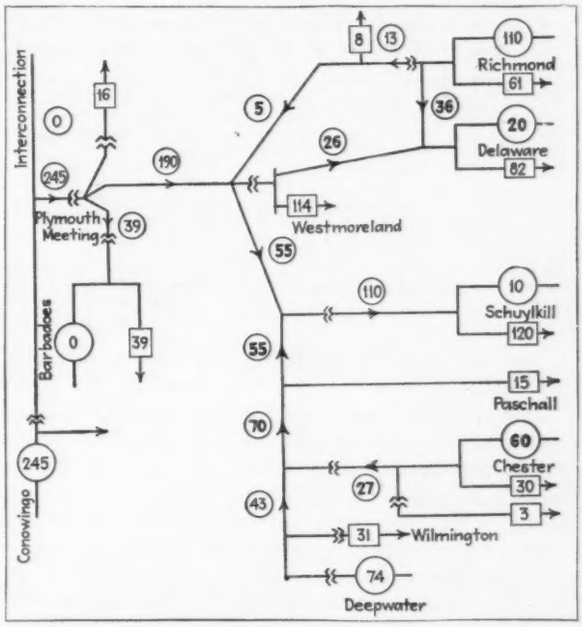
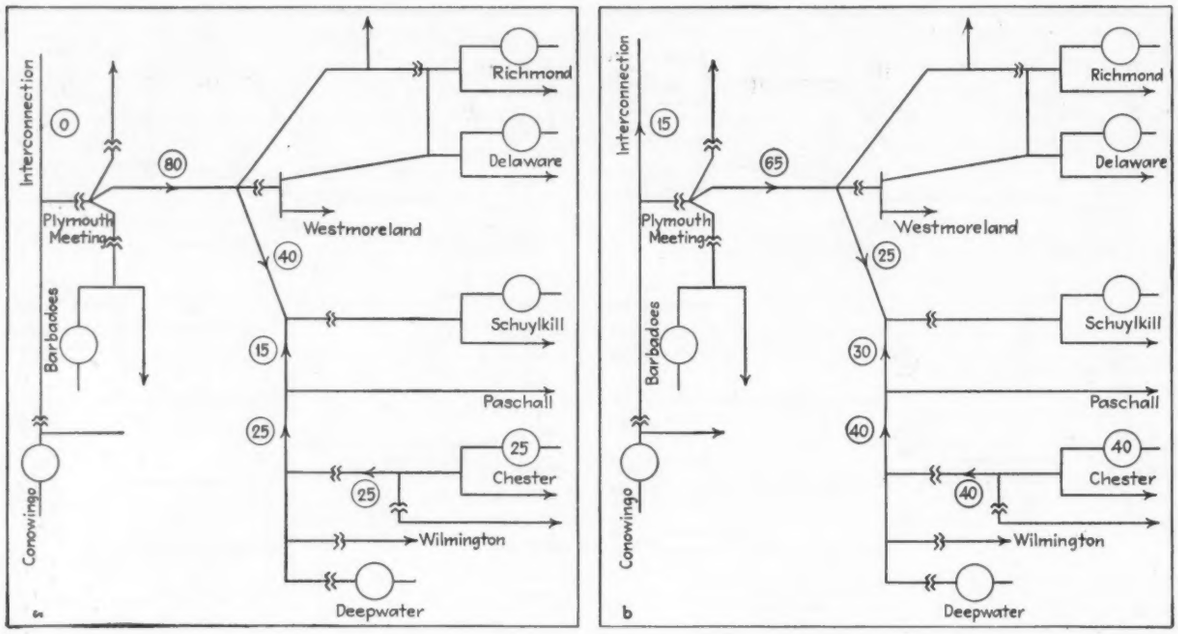


Fig. 3 c—System loading changes by transferring 20,000-kw. generation from Chester to Delaware

Compare with previous conditions in Fig. 3a. The values affected are emphasized.



Figs. 4 a and b—Effect on reactive loading of 20,000-kw. transfer at 80 per cent power factor

Based on transfer from Chester to Plymouth Meeting with Chester supplying 15,000 rkva. Fig. 4a shows the normal reactive line loading before the transaction and Fig. 4b the conditions afterward. All system loadings not affected by the transfer are omitted.

The per cent increment line loss at 200,000 kw. or rkva., therefore equals

$$\frac{0.2\,R}{(kv.)^2} \times (kw.\text{ or } rkva.) = \frac{0.2 \times 0.48 \times 200{,}000}{66 \times 66} = 4.4 \text{ per cent.}$$

A straight line can, therefore, be drawn through the origin with a value of 4.4 per cent at 200,000 kw. (or *rkva.*). This line gives the per cent increment loss for all loads from 0 to 200,000 kw. (or *rkva.*) for the three Plymouth Meeting transformers and the three Plymouth Meeting-Westmoreland lines.

Should a line and transformer be taken out of service, the per cent increment loss for the remaining two lines and transformers and service can be obtained by multiplying the values for three lines and transformers by three halves.

Use of increment loss curves

Use of the per cent increment loss curves can best be illustrated by several examples of energy transfer. Let us assume that the system loading is as shown in Fig. 3a and that a 20,000-kw. block of power at unity power factor is to be delivered to the Plymouth Meeting interconnection from Chester station. The changed loadings on the transmission lines due to the transfer are emphasized in Fig. 3b. As can be seen by comparing Figs. 3a and 3b, only five elements in the transmission system are affected by this transaction. These are listed in Table I, which also shows the steps involved in determining the additional or positive loss and the reduced or negative loss applicable to the sale of the 20,000-kw. block to the interconnection.

The algebraic sum of the losses on the individual transmission lines, due to the load transfer, is, therefore, 840 kw., or 4.2 per cent of the 20,000-kw. block. In this case, therefore, the 4.2 per cent transmission line loss can be added to the incremental generating cost at Chester to arrive at the cost of the 20,000-kw. block at unity power factor corrected for transmission line loss to the metering point at Plymouth Meeting. Interchange power between interconnecting companies is usually at unity power factor, in which case the loss as calculated is correct regardless of the power factor of the transmission lines between the generating source and the metering point.

That the loss due to any additional block of power at unity power factor is entirely independent of the power factor of the original load on the transmission tie lines can be demonstrated by taking an extreme case of poor power factor loading on a transmission line. Assume that a 66-kv. line of 10 ohms resistance is transmitting 10,000 kw. at 10 per cent power factor, and it is proposed to transfer an additional block of 20,000 kw. at unity power factor over this line.

The increment loss due to the additional block of load is dependent only on the kw. loading on the line and is determined by the formula as follows:

$$\text{Per cent increment loss} = \frac{0.2\,R \times kw.}{(kv.)^2} = \frac{0.2 \times 10}{(66)^2} \times 20{,}000\ kw.$$

$$= \frac{0.2 \times 10 \times 20{,}000}{4{,}356} = 9.18 \text{ per cent.}$$

$$\text{Kw. loss} = 20{,}000\ kw. \times 0.0918 = 1{,}836\ kw.$$

Table I—Method of Calculating Net Transmission Loss of 20,000-Kw. Transfer

Values based on Figs. 2, 3a and 3b.

Transmission Line	Mw. Load Before Sale	Mw. Load After Sale	Midpoint Mw. Load	Increase or Decrease in Mw.	% Increment Loss	Kw. Loss
Plymouth Meeting-Westmoreland	190	170	180	—20	4.0	—800
Westmoreland-Schuylkill	75	55	65	—20	.8	—160
Schuylkill-Paschall	35	55	45	+20	1.4	+280
Paschall-Chester	50	70	60	+20	6.8	+1360
Chester transformers	7	27	17	+20	.8	+160

Total loss equals 840 kw. or 4.2% increment loss

The I^2R loss on the line at 10,000 kw. load of 10 per cent power factor is equal to:

10,000 *kw.* at 10 per cent power factor = 100,000 *kva.*

100,000 *kva.* at 66 *kv.* = 874.8 amp.

$$Kw.\ loss = \frac{3\,I^2R}{1{,}000} = \frac{3 \times 874.8^2 \times 10}{1{,}000} = \frac{3 \times 765{,}258 \times 10}{1{,}000}$$

$$= 22{,}958 \text{ kw.}$$

The additional block of 20,000 kw. unity power factor load will increase the line loading to 30,000 kw. at 28.867 per cent power factor. The loss on the line would then be:

30,000 kw. at 28.867 per cent power factor = 103,923 kva.

103,823 kva. at 66 kv. = 909.1 amp.

$$\text{Kw. loss} = \frac{3\,I^2R}{1{,}000} = \frac{3 \times 909.1 \times 10}{1{,}000} = \frac{3 \times 826{,}463 \times 10}{1{,}000}$$

$$= 23{,}794 \text{ kw.}$$

The loss on the line due to the additional 20,000-kw. block of load transferred is thus:

Kw. loss on 20,000 kw. transmitted = 24,794 *kw.* — 22,958 *kw.*

= 1,836 *kw.*,

which is the same value as calculated by the per cent increment loss method. By a similar calculation, assuming that the original 10,000 kw. load on the transmission line was at any other power factor, the same loss of 1,836 kw. will be obtained for the additional block of 20,000 kw. Therefore, in all cases where the additional load is unity power factor, it is not necessary to consider correction for power factor.

Power-factor correction

Correction for power factor is necessary if the block of load transferred is at other than unity power factor. This correction can be made conveniently by considering only the reactive kva. loading on the transmission lines involved. If the 20,000-kw. block of power delivered to the interconnection in Fig. 3b were at 80 per cent power factor instead of unity power factor, this would be equivalent to delivering 15,000 reactive kva. in addition to the block of 20,000 kw. Fig. 4a shows the normal reactive kva. loading on the transmission lines before the transaction with 18,000 reactive kva. generated at Chester. Actually, as there are synchronous condensers at Plymouth Meeting and Westmoreland, 15,000 rkva. delivered to the interconnection would probably be generated at these points. Assuming, however, that the 15,000 rkva. would be generated at Chester, Fig. 4b shows the reactive power loads on the transmission lines after the transaction.

Table II shows the calculations for determining the positive and negative losses due to the 15,000 rkva. delivered to the interconnection.

Table II—Losses Due to 15,000-Rkva. Transfer

Values based on Figs. 2, 4a, and 4b.

Transmission Line	Mega. Rkva. Load Before Sale	After Sale	Midpoint Rkva. Load	Increase or Decrease in Rkva.	Per Cent. Inc.	Kw. Loss
Plymouth Meeting-Westmoreland	80	65	72.5	—15	1.6	—240
Westmoreland-Schuylkill	40	25	32.5	—15	.4	— 60
Schuylkill-Paschall	15	30	22.5	+15	.7	+105
Paschall-Chester	25	40	32.5	+15	3.8	+570
Chester transformers	25	40	32.5	+15	1.2	+180
						+555 kw.

This loss of 555 kw. due to the 15,000 rkva. amounts to 2.8 per cent of the 20,000-kw. load. This makes a total of 4.2 per cent + 2.8 per cent, or 7.0 per cent loss applicable to the 20,000-kw. load. The 7.0 per cent can be added to the incremental generating costs at Chester to determine the cost of the 20,000 kw., 80 per cent power factor block at the metering point at Plymouth Meeting.

Effect on economical load allocation within system

Transmission tie line losses may have considerable effect on correct load allocation, particularly on systems where the efficient stations are connected to the major load distributing centers by relatively high-loss lines. Referring to Fig. 3a, under the loading conditions shown, the Chester increment cost at the station bus may be less than that for Delaware. However, if an additional block of 20,000 kw. load were generated at Chester and a corresponding reduction were made in the Delaware generation, the transmitted loads on most of the transmission lines would be increased as shown in Fig. 3c, and an additional loss on the tie lines would result. The station cost corrected for tie line losses can be conveniently compared by correcting the costs for increment line losses to some common point, as at the Schuylkill station high-tension bus.

The Chester increment cost at the Chester bus for the 20,000-kw. block would be increased by 8.8 per cent to correct for transmission line loss to Schuylkill station. This percentage is computed as follows:

Transmission Line	Mw. Load Before	Mw. Load After	Midpoint Mw. Load	Increase or Decrease	Per cent Increment Loss	Kw. Loss
Chester transformers	7	27	17	+20	0.7	140
Chester-Paschall	50	70	60	+20	6.7	1,340
Paschall-Schuylkill	35	55	45	+20	1.4	280
Total loss						1,760

Total loss equals 1,760 kw. or 8.8 per cent of 20,000-kw. block

In the same manner, the Delaware increment cost at the Delaware bus for the 20,000-kw. block if generated at Delaware would be decreased by 2.6 per cent to correct to the Schuylkill bus, the percentage being determined as follows:

Transmission Line	Mw. Load Before	Mw. Load After	Midpoint Mw. Load	Increase or Decrease	Per cent. Increment Loss	Kw. Loss
Delaware-Westmoreland	26	16	21	—10	3.2	—320
Delaware-Richmond	36	26	31	—10	3.7	—370
Richmond-Westmoreland	5	15	10	+10	0.3	+ 30
Westmoreland-Schuylkill	55	75	65	+20	0.7	+140
						—520

Total loss equals 520 kw. or 2.6 per cent. of 20,000-kw. block .

By generating the 20,000 kw. at Delaware, therefore, the cost of the block is reduced by 2.6 per cent due to reduction in transmission line losses, whereas if generated at Chester the cost of the block is increased by 8.8 per cent, or a net gain of 11.4 per cent in reduced transmission line losses by generating at Delaware. The block should, therefore, be generated at Delaware due to the effect of the transmission losses. This indicates the necessity of correcting incremental costs for transmission losses in arriving at correct load allocation.

Other applications where the incremental method of determining transmission line losses may be used are as follows:

1. Determination of reduction in transmission line losses by the installation of synchronous condenser capacity.

2. Comparison of locations for the installation of additional generating capacity from the standpoint of transmission line losses.

3. Determination of reduction in transmission line losses by installation of additional transmission capacity.

4. Determination of the amount of reactive kva. to be carried on each generating and synchronous condenser station in order to reduce transmission losses.

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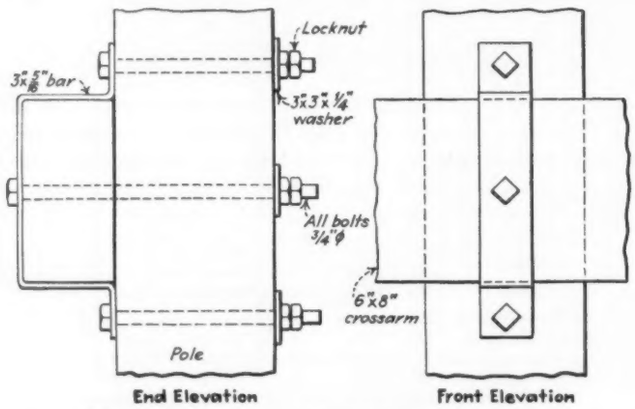
Crossarms Strengthened for 110-Kv. Service

By H. V. INGERSOLL

Stone & Webster Engineering Corporation, Boston

In order to minimize the possibility of a crossarm falling, due to minor damage, a crossarm clamp was developed by the Stone & Webster Engineering Corporation on the wood H-frame 110-kv. transmission line between Petersburg, Va., and Roanoke Rapids, N. C., for the Virginia Electric & Power Company which assures high reliability in maintaining the crossarms in position.

Previous experience on H-frame lines indicated that some trouble might be expected in the use of two-bolt attachments of the crossarm to the pole due to the warping and settling of the structure after it had been in operation, with the resultant splitting of the wood at



Three-bolt clamp with locknuts improves crossarm support

the bolt holes. While a single bolt attachment provided greater flexibility, it was deemed too weak structurally because of the small amount of bearing surface provided on the wood fibers. A heavy steel clamp was, therefore, designed which clamps the 6x8-in. crossarm to the pole as shown in the accompanying illustration, using one bolt through arm and pole and one bolt above and below the arm attaching the clamp to the pole. This clamp is sturdy enough to hold the arm in position in the event that the main bolt loosens. As an added precaution locknuts are used on all the bolts further to insure their tightness.

READERS' FORUM

Rename Kilowatt-Hour "Edison"

To the Editor of the ELECTRICAL WORLD:

I need not remind you that all of the fundamental electrical units of measurement are arbitrary units which have been given the names of famous scientists of past ages. In view of these facts and Mr. Edison's death, I would suggest that steps be taken to rename the kilowatt-hour, calling it the "Edison." Such a move, if it could be brought about, would perpetuate his name throughout all generations and would at the same time give industry and science a very simple expression, easily abbreviated, instead of the kilowatt-hour.

I fully realize that any such change would probably involve great difficulties, and as a matter of fact it may be impossible to accomplish this result.

Niagara Hudson Power Corporation, Syracuse, N. Y. **W. C. PEARCE.**

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Association of Edison Companies Pays Tribute to Its "Chief"

To the Editor of the ELECTRICAL WORLD:

We are deprived of the physical presence of our beloved chief and dean. But we are surrounded on all sides by memorials of him. Our great electric systems which supply light, power and heat are merely developments in natural evolution of the system which he conceived and, in essence, initiated. Our central stations, distributing systems, lamps, motors, motored appliances, switches and fuses are memorials of him. He inaugurated the Age of Electricity.

We, little men, occupy ourselves with one or another aspect of some detail of electric service. He, great man, more than fifty years ago conceived and initiated the essential and fundamental elements and co-ordinated them into a complete system for generation, distribution and utilization of electricity.

"Every great and commanding movement in the annals of the world," wrote Emerson, "is the triumph of some enthusiasm." Edison personified enthusiasm. It was the motive force of his painstaking genius. Electric service, as we know it today, is the triumph of his enthusiasm.

His life was dedicated to revolutionary achievements, varied in character but alike in benefaction to mankind. Through them the world's work is done more easily; the comfort of the people is enhanced, and opportunities for pleasure are enlarged. The world is a better place in which to live because Edison lived and wrought.

Our appreciation of Edison is not limited, however, to admiration for his achievements. His capacity for hard work, his acumen and foresight, his honesty, his loyalty to associates, his adherence to sound principles and his independence of tradition combine to make him an admirable figure of a man to be held before this and future generations as worthy of emulation.

As we mourn his death, we also celebrate his life. It is our part worthily to carry on in the traditions which he exemplified. **PRESTON S. MILLAR,**

Association of Edison Illuminating Companies. Secretary.

Men of the Industry

C. E. Norris New President of Northern New York Utilities

CHARLES E. NORRIS, who was elected president of the Northern New York Utilities, Inc., as recently announced in the ELECTRICAL WORLD, has been actively identified with the Carlisle interests since 1925. In that year Mr. Norris was elected president of F. L. Carlisle & Company, Inc., and later he became vice-president and secretary of

the Niagara-Hudson Power Corporation, a position he will retain in addition to the presidency of Northern New York Utilities. He is a former Carthage (N. Y.) attorney and for many years handled many water-power cases, being associated with Kilby, Norris & Smith of that city.

Mr. Norris is a native of Port Leyden, N. Y., and after removing to Carthage he was a clerk in the post office and studied law under the late Judge A. E. Kilby. He is a graduate of Albany Law School. Previous to becoming active in Carlisle companies he often represented them in legal matters. He has also served as supervisor from the town of Champion and for four years held the office of Deputy Commissioner of Excise.

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FRANKLIN T. GRIFFITH, president of the Pacific Northwest Public Service Company and of its principal operating subsidiary, the Portland General Electric Company, Portland, Ore., has been elected a regional vice-president of Albert E. Peirce & Company, the headquarters of which are in Chicago. The Peirce organization, which conducts a general investment business, has charge of all customer-ownership-stock selling for the Central Public Service Corporation, which controls the Pacific Northwest Public Service Company.

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ALFRED E. WALLER has joined the Clark Controller Company's organization and will make his official headquarters at the Sundh Electric Company's plant at Newark, N. J. Mr. Waller's former connections were as chief engineer of the Ward-Leonard Company, Mount Vernon, N. Y.; managing director of the National Electrical Manufacturers' Association and recently in an executive position with the General Cable Corporation.

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John Fritz Medal Awarded to Dr. Pupin

DR. MICHAEL I. PUPIN, professor of electromechanics and director of the Phoenix Research Laboratory at Columbia University, has been made the recipient of the John Fritz gold medal, highest of American engineering honors, for his achievements as "scientist, engineer, author, inventor of the tuning of oscillating circuits and the loading of telephone circuits by inductance coils." Dr. Pupin is a graduate of Columbia University and the University of Berlin. He received the degree of doctor of sciences from Columbia and Princeton Universities and doctor of laws from Johns Hopkins University, New York University, Muhlenberg College and other institutions. He is widely known among engineers and scientists for his researches and inventions in connection with long-distance telephone lines and for his advanced work in the passage of electricity through gases, electrical resonance, and many other scientific subjects.

Dr. Pupin is a past-president of the American Institute of Electrical Engineers and the American Association for the Advancement of Science. He is a member of the National Academy of Sciences, New York Academy of Sciences, American Philosophical Society, American Physical Society and other scientific associations and a past-chairman of the Engineering Foundation. Dr. Pupin has previously been honored with the Edison medal of the American Institute of Electrical Engineers and the Carson gold medal of the Franklin Institute.

P. R. Knapp Assumes New Engineering Duties

P. R. KNAPP, who has been connected with the Toledo Edison Company since 1919, has been appointed superintendent of distribution of that company. Mr. Knapp is a graduate of the Worcester Polytechnic Institute, and after the completion of his technical studies he became associated with Prof. Albert S. Richey. Subsequently he entered the

employ of the Worcester (Mass.) Electric Light Company and later of the New England Power Company on transmission-line work, and then of Henry L. Doherty & Company as junior engineer. Following discharge from military service after the World War, he was appointed engineer in charge of design and construction of transmission lines for the Toledo Edison Company. This assignment was made in 1919. Mr. Knapp took a major part in the construction of 66-kv. belt lines around Toledo and the substations on these lines. Later he was given charge of power-plant and substation engineering. It was in 1924 that he was named assistant superintendent of electrical distribution and transmssion.

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OWEN D. YOUNG, chairman of the board of directors of the General Electric Company, was made the recipient of the honorary degree of doctor of laws by Wesleyan University at the celebration of that institution's hundredth anniversary.

OBITUARY

Dr. Samuel W. Stratton

DR. SAMUEL W. STRATTON, distinguished educator and physicist, chairman of the corporation and formerly president of the Massachusetts Institute of Technology, died suddenly, October 18, at his home in Back Bay, Boston, just after dictating a tribute to his friend, Thomas A. Edison. Death was due to the constriction of blood vessels. Dr. Stratton returned last week from the Faraday celebration in England and appeared in the best of health. He was 70 years of age.

An exponent of the advantages of research, he served for 21 years as director of the Bureau of Standards, Washington, D. C., during a period of intensive industrial development in this country. With him as organizer and director the bureau sprang from a division in the Coast and Geodetic Survey concerned with the standardization of weights and measures to the largest physical laboratory in the world, where scientific work of inestimable value to American business and industry was conducted.

Dr. Stratton was born in Litchfield, Ill., and in 1884 was graduated from the University of Illinois, where he later became professor of physics and electrical engineering. From 1892 to 1901 he was with the physics department of the University of Chicago. The plan for the Bureau of Standards formulated by Dr. Stratton was adopted by Congress in 1901 and he became its head, retaining that position until 1922, when he resigned to assume the presidency of the Massachusetts Institute of Technology. Last year he announced a revision in the organization at the institute whereby he became chairman of the corporation and called Dr. Karl Taylor Compton, head of the department of physics at Princeton, to be president.

In the course of his long and useful career Dr. Stratton has been the recipient of many honors. From his alma mater he received the honorary degree of doctor of engineering in 1903, and in the same year he received the degree of doctor of science from the University of Pittsburgh, then called the Western University of Pennsylvania. The same degree in 1909 was conferred upon him by the University of Cambridge and in 1919 by Yale University. He was made a chevalier of the Legion of Honor in 1909; the Franklin Institute awarded him the Cresson medal and the National Academy of Sciences its welfare medal. Last April he represented the United States at the International Conference on Weights and Measures at Sèvres, France. Dr. Stratton was a member of many learned societies.

In commenting on the death of Dr. Stratton, Elihu Thomson said:

The unexpected loss of Dr. S. W. Stratton is a heavy blow to those who have been intimate with him during a long series of years and who had learned to have a high appreciation of his personal qualities as well as his skill in organization and his deep knowledge of science. It was when he had the task of establishing the Bureau of Standards in Washington, in reality his greatest achievement, that I, as one of the appointees on the visiting committee for the government, first met him, since which time I have been constantly in touch with him, and especially so during his presidency of the Massachusetts Institute of Technology. His was a most genial personality that won friends everywhere, and his scientific attainments placed him in the first rank. Meeting him for the last time in London at the recent centenary celebration of the Royal Institution and of Faraday's work there, it is indeed hard to realize that he is no longer one of us, as he then appeared in such good health. His many friends will mourn his loss and treasure his memory as that of one who all too soon has gone from among them.

Wide World

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EDWARD C. CURSONS, assistant treasurer of the Buffalo General Electric Company and of the Buffalo, Niagara & Eastern Power Corporation, died suddenly at his desk, as the result of a heart attack, October 12. Born and educated in Buffalo, Mr. Cursons spent several years in various business enterprises before entering the public utility field as an employee of the old Cataract Electric Supply Company. One year later, in 1905, when this company was merged with the Cataract Power & Conduit Company, Mr. Cursons was made assistant treasurer. Ten years later, in 1915, he was elected assistant treasurer of the Buffalo General Electric Company, the position he held up to the time of his death. Two years ago he assumed the duties of assistant treasurer of the Buffalo, Niagara & Eastern Power Corporation.

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W. S. FISHER, a director of the New Brunswick Power Company and formerly president of the Canadian Manufacturers' Association, died at his home in St. John, N. B., October 15. Mr. Fisher, who was 77 years of age, had been identified in an executive capacity with various industrial enterprises.

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J. GEORGE KAELBER, pioneer in the electrical industry, died at his home in Rochester, October 13, in his seventy-third year, after an illness of three months. A native of Germany, Mr. Kaelber removed to this country in 1873 and entered the electrical industry, then in its infancy. He installed electric lighting systems in more than 500 cities and towns in various sections of the country. He retired in 1922. Mr. Kaelber was an associate of the American Institute of Electrical Engineers.

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GEORGE M. OGLE, manager of the power and industrial department of the National Electric Power Company, New York, and an electrical engineer noted for his research on the effects of electrical shocks on the human body, died suddenly, October 14, in his sleep in Dayton, Ohio, while on a business trip. Mr. Ogle was 40 years old. A native of Louisville, Ky., and a graduate of Vanderbilt University, he had held a number of executive and technical positions in the electrical engineering field and was considered one of the nation's foremost authorities on the operation of the electric chair. Before the World War Mr. Ogle was connected with the Edison Electric Illuminating Company of Boston and the Brooklyn Edison Company. From 1918 to 1920 he was in charge of the electrical shipping division on the Atlantic Coast for the United States Shipping Board. More recently he had served as chief electrical engineer for the Vulcan Iron Works of Jersey City and as a power specialist for the General Electric Company, serving both in New York and Schenectady. In 1925 he was appointed consulting engineer for the General Engineering & Management Corporation and two years later he assumed the position which he held at his death. Mr. Ogle was a member of the American Institute of Electrical Engineers.

Financial and Statistical News

INCREASED buying early this week resulted in decided improvement in virtually all sections of the bond list. While new financing by power and light companies continues almost at a standstill, any sustained rise in the bond market is expected to bring out many new issues, as several companies have operations to carry out and are awaiting such a move. Several short-term issues sold in the last three years, for example, must shortly be taken up. The current market is not receptive even to high-grade first mortgage bonds.

——STOCKS OF ELECTRIC MANUFACTURING COMPANIES HAVE IMPROVED with a rising market and on reasonably satisfactory earnings reports, considering the general state of business. Westinghouse shows a material gain in the third quarter in net income and General Electric shows a reduction in the decline from normal.

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Output Slightly Larger

ELECTRICAL ENERGY GENERATED by the light and power industry has recently been somewhat greater than in mid summer, but less than in the corresponding periods of the past two years, according to figures made public by the National Electric Light Association. During the past few weeks it has been down 3 or 4 per cent compared with 1930. For the week ended October 10 it fell short by 4.1 per cent; for that of October 17 by 4.1 per cent.

Comparative weekly figures are given in the following table:

	1931	1930	1929	1928
September 12.....	1,582	1,727	1,806	1,604
September 19.....	1,663	1,722	1,792	1,614
September 26.....	1,660	1,714	1,778	1,673
October 3.....	1,646	1,711	1,819	1,637
October 10.....	1,653	1,724	1,806	1,651
October 17.....	1,656	1,729	1,799	1,665

Regionally, on the Atlantic seaboard the output has lately been running close to last year's; in the central industrial area it is still down 7 or 8 per cent, though the Chicago district is doing a little better than that, and on the Pacific Coast it has been off 1.5 to 2.5 per cent.

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Electricity's Future Brighter than Past

ELECTRICITY WILL PLAY a larger part in the next decade than it did in the last, S. Z. Mitchell, chairman of the board of directors of Electric Bond & Share Company, told the stockholders of the company last week. Electric power is destined to play an increasingly important part in the industrial development of the country. Mr. Mitchell continued:

After every depression, basic industries have risen to new levels of development and prosperity. Following the depression of 1921 and from that year to 1929, the gross annual revenues of all electric companies in the United States increased from $944,000,000 to $1,939,000,000, or more than doubled.

Electric power is contributing more to industrial efficiency and domestic comfort today than it did in 1921. Standards of living have improved. New uses for electricity are being introduced.

Electric Bond & Share Company owns large blocks of the securities of its associated companies which own the equity stocks of operating utilities doing business in 32 states of the United States and in thirteen foreign countries. These companies, which represent the foundation of its business, supply an essential service to more than 25,000,000 people.

For more than 40 years I have participated in the steady progress of the electric industry. I have seen it grow from one station, servicing a few hundred carbon lamps, to become one of the leading industries in the United States. Electric Bond & Share Company has been intimately associated with that growth since its organization in 1905.

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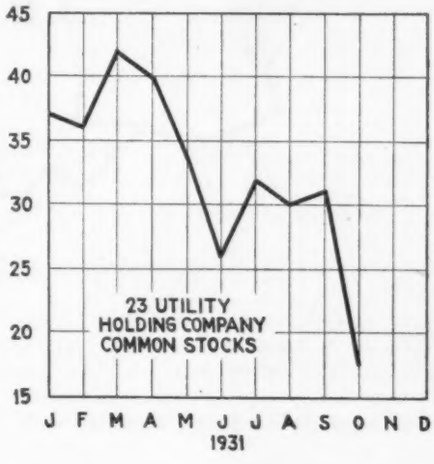
Utility Common Stocks Liquidated 84 per Cent



THERE is much discussion in brokerage circles and elsewhere relative to the extent to which liquidation, as represented by the decline in common stocks, has been completed. Market analysts differ, naturally, but many brokerage house letters are this week definitely suggesting that present levels are "buying levels."

Any comparison of present prices of power and light company common stocks with those of a year or two years ago suggests that something like a five-for-one, or in many cases a ten-for-one split has taken place. Here are a few current (October 16) prices of holding company stocks in comparison with the 1929 high quotation for the same stock:

	1929 High	Current
American & Foreign Power Company	199	14
American Power & Light Company...	176	18
American Gas & Electric Company...	225	39
American Water Works & Electric Company.....	199	29
Electric Power & Light Company.....	87	22
Commonwealth & Southern Corp.....	32	6
National Power & Light Company...	72	17
North American Company.....	187	37
Standard Gas & Electric Company...	244	36
United Corporation.....	76	13

The average price of this representative group of utility stocks has been reduced 84 per cent.

Power and light stocks are today selling at around ten times 1930 earnings and probably twelve times indicated 1931 earnings. This ratio was regarded as approximately right before investors began to discount future possibilities in a large way, running utility averages up close to 35 times earnings.

A factor not always taken into account in estimating 1931 values is the fact that capital structures are being altered remarkably little. New financing was greater up to the end of September than for the corresponding part

of 1930, but there is a much larger volume of refunding. The offer and exercise of rights and option warrants has been almost precluded by the erratic behavior of the market. Thus earnings per share are not being lowered by a large increase in outstanding stock.

Another interesting comparison is between present price levels and book values. Electric Bond & Share stock, for example, had a book value at the end of 1930 of $58.64 and the current market is around $22. Its subsidiary, American & Foreign Power Company, had a book value on its common stock at that time of $23.85. Its current market is about $17. United Corporation sells around $15 and had a book value for 1930 of nearly $28.

It is not the purpose of this article or the function of this publication to suggest the purchase of common stocks. Whether or not 84 per cent liquidation is adequate depends as much on the unreasoned judgment of the mass of investors as upon any statistical facts that can be assembled, including asset value.

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Pound Sterling Discount and American Utilities

FURTHER INFORMATION on the effect of the British currency crisis upon American utilities with holdings in Britain is found in the annual report of Utilities Power & Light Company. Although that company has $35,000,000 invested in Britain, more than $28,000,000 of it is in the form of obligations payable in dollars. The balance of more than $6,000,000 is in the common stock of Greater London & Counties Trust, Ltd., and is, of course, payable in sterling.

President Harley L. Clarke pointed out that: "The income derived from British properties has always been reinvested in extensions and improvements to these properties; therefore no loss is sustained through fluctuation in exchange. The financial conditions of Utilities Power & Light makes it possible to continue this policy. If, however, this income were to be paid over in dollars to this company, an exchange rate of $3.80 on the pound would penalize the company's consolidated net income to the extent of $450,000, or less than 14 cents a share on its class B and common stocks. If, as anticipated by many, the decline in the value of the pound sterling will result in increased industrial activity in Great Britain, the earnings of the Greater London & Counties Trust, Ltd., will increase, for its subsidiaries are prepared as a consequence of recently completed power stations to meet demands of reviving business."

Power Output Turns Upward

THE LARGEST INCREASE in electricity output since the first of the year was made by the Middle West Utilities System during the week ended October 10, which showed an increase of 9.6 per cent over the corresponding week of last year, without including new companies acquired during the past year.

The output was 87,740,764 kw.-hr. for the week ended October 10, 1931, compared with 80,037,043 kw.-hr. for the corresponding week last year.

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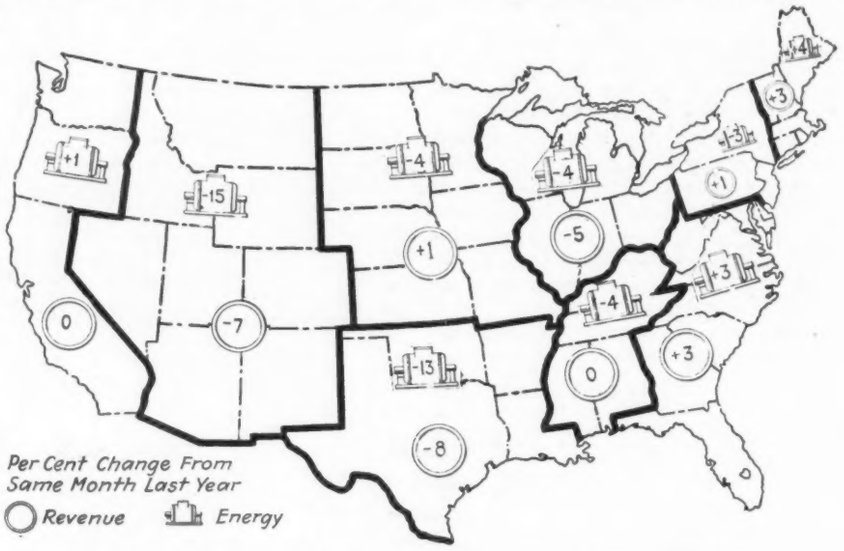
Utilities Hold Last Year's Level

ONCE again electric light and power companies report earnings that, on the whole, closely duplicate those of the corresponding month in 1930. On the basis of these returns the total August revenue is estimated at $167,380,000 against $168,100,000 last year, the difference being only 0.4 of 1 per cent. The amount is almost identical with the July figure, which was 0.6 per cent above last year's July.

Operating expenses, as in other recent months, show a decrease compared with 1930; the total of $75,590,000 is down 3.5 per cent, leaving an appreciable gain in net. Energy output, 7,158,838,000 kw.-hr., was 3.0 per cent less than a year ago, against 1.3 per cent in July,



Activity rising on Atlantic seaboard; mid-continent still low

Table I—Central-Station Financial Operations in the United States

Compared with Corresponding Month of Previous Year

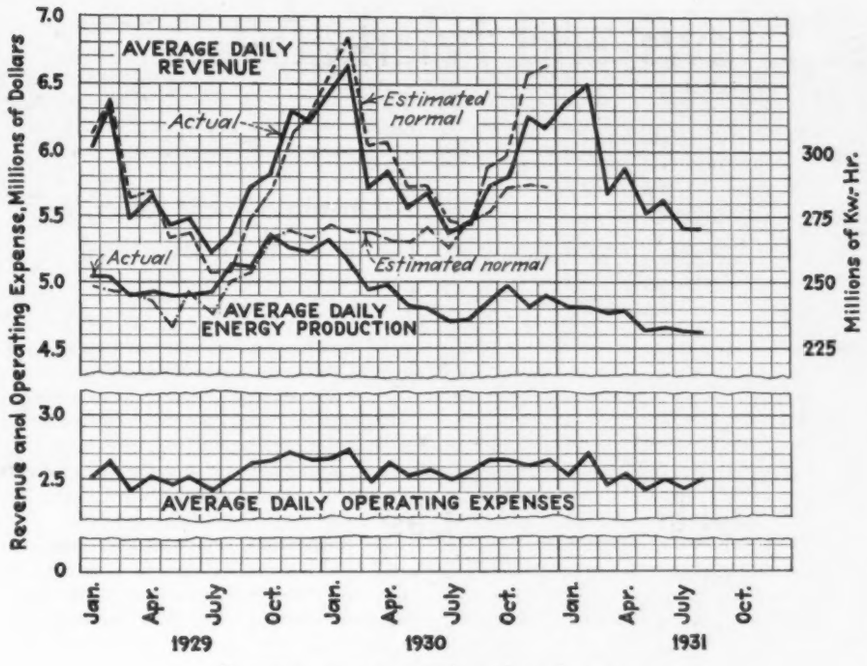
Month	Total Gross Revenue from Sale of Energy*			Total Operating and Maintenance Expense†		
	1931 Thousands	1930 Thousands	Per Cent Inc.	1931 Thousands	1930 Thousands	Per Cent Inc.
May	171,550	172,900	—0.8	74,560	77,900	—4.3
June	168,510	170,200	—1.0	74,340	76,400	—2.7
July	167,190	166,200	+0.6	75,170	77,500	—3.0
August	167,380	168,100	—0.4	75,590	78,300	—3.5

Table II—Central-Station Fuel Consumption in the United States‡

Compared with Corresponding Month of Previous Year

Month 1931	Coal		Oil		Gas	
	Short Tons	Per Cent Increase	Barrels	Per Cent Increase	Thousands Cubic Feet	Per Cent Increase
May	2,703,414	—10.9	532,820	—10.0	9,889,055	+ 3.8
June	2,721,290	— 7.8	612,973	+ 0.4	11,549,126	+17.1
July	2,913,370	— 9.0	704,100	— 0.9	12,613,785	+20.6
August	2,978,314	—12.7	711,505	— 4.1	12,449,131	+13.1

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.
†Do not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions. ‡As collected by the U. S. Geological Survey.



Summer energy sag less than last year

and brings the daily average to the lowest point thus far this year, a fraction of a per cent lower than in May.

Of the energy output 31.5 per cent came from water power; in July it was 34.5 per cent, in June 37.5 per cent. In general, the abnormally low hydroelectric production of 1930 is being repeated, rainfall in most sections of the country having been insufficient to bring a recovery from draught conditions.

Despite the decrease in output intercompany sales of energy for resale are still expanding, apparently stimulated by the need of utilizing the most efficient stations to the fullest possible extent through system interconnections and avoiding the operation of less economical plants so far as is practicable.

While total revenue was nearly the same as it was a year ago the distribution differed. Along the Atlantic seaboard gains are again evident, particularly in New England with its 3.3 per cent increase, following one of 4.1 per cent in July; and constituting an advance of 1.6 per cent compared with that month.

Table III—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1931	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
May	7,191,717	—4.7	2,964,720	—1.1	4,226,997	—7.0	1,862,000	+6.5
June	7,017,221	—3.1	2,637,643	—5.5	4,379,578	—1.6	1,901,000	+5.8
July	7,263,960	—1.3	2,508,307	—4.1	4,755,653	+0.3	1,956,000	+4.7
August	7,158,838	—3.0	2,262,269	0	4,896,569	—4.4	2,025,000	+1.5

Table IV—Regional Operations, Revenue and Energy Output in August, 1931

Compared with Corresponding Month of Previous Year

Region	Revenue		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	167,380	—0.4	7,158,838	— 3.0	2,262,269	0	4,896,569	— 4.4
New England	16,930	+3.3	478,392	+ 4.1	161,687	+22.4	316,705	— 3.3
Middle Atlantic	42,300	+1.4	1,726,055	— 3.4	385,456	+ 3.4	1,340,599	— 5.2
East North Central	39,200	—4.5	1,633,301	— 4.1	98,230	— 2.3	1,535,071	— 4.2
West North Central	14,380	+1.0	475,782	— 4.4	84,034	—12.8	391,748	— 2.4
South Atlantic	18,440	+2.7	804,920	+ 3.1	402,894	+76.7	402,026	—27.1
East South Central	5,670	+0.4	273,426	— 4.4	216,008	+13.8	57,418	—40.4
West South Central	9,270	—8.4	408,339	—12.9	4,794	+174.0	403,545	—13.6
Mountain	4,140	—6.5	260,460	—15.1	209,780	—15.9	50,680	—12.1
Pacific	17,050	+0.3	1,098,163	+ 0.6	699,386	—21.0	398,777	+93.5

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central-station operations.

In the central industrial area, in the southwest with its oil industry and in the Mountain States, where much power is used for mining, the subnormal condition of the respective dominant industries is again reflected in revenue and energy output materially less than in 1930. The percentages are given in Table IV.

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NEWS BRIEFS

The Bank Commissioner of the State of New Hampshire has ruled that the first and refunding mortgage 5 per cent bonds of the Tennessee Electric Power Company due June 1, 1956, are legal investments for savings banks in New Hampshire. These bonds are also legal investments for savings banks in Maine and Rhode Island.

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Electric Public Service Company has omitted the dividend due on its preferred stock.

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The California Railroad Commission has extended from September 30, 1931, to December 31, 1931, the time in which the Pacific Gas & Electric Company is permitted to exchange its 5½ and 6 per cent preferred stock for preferred stock of the Great Western Power Company of California and the Feather River Power Company under previously announced terms.

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RECENT LISTINGS

The New York Stock Exchange has authorized the listing on or after October 1 of 165,934 additional shares (no par) common stock of the North American Company on official notice of issuance as a stock dividend, making a total number of 7,399,822 shares applied for.

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The listing on the New York Stock Exchange of 34,000 additional shares of class A stock (no par value) of the Utilities Power & Light Corporation has been authorized on official notice of issuance as a payment in full by sale to stockholders in lieu of cash dividend, making the total amount applied for 1,901,000 shares.

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There have been placed on the Boston Stock Exchange list $12,000,000 secured 5½ per cent consolidated refunding gold bonds of the Metropolitan Edison Corporation, to be dated September 1, 1931, and to mature September 1, 1971, and $10,000 secured 6 per cent consolidated refunding mortgage bonds, to be dated September 1, 1931, and to mature September 1, 1981.

Business News and Markets

New Electric Code Makes Its Appearance

THE NEW CODE of the electrical industry, LCODE, already discussed in these columns, especially in the issue of February 21, page 385, will be in effective operation November 16. The complete industry code book has just been issued by the Business Code Company, New York.

A joint industry committee representative of the Electragists, N.E.L.A., wholesalers, radio manufacturers and wholesalers, and S.E.D., co-operated in 1930, under N.E.M.A. sponsorship, to formulate and publish a telegraph code book to include all words and phrases used in the purchase and sale of electrical equipment and supplies. After continuous work for over a year by the joint committee and its subcommittee, the volume is now available as a means of legitimate economy devised within the industry itself.

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Commerce Bureau Studies Electrical Selling Costs

AN UNUSUALLY DETAILED and comprehensive study of the problem of the distribution of wholesale electrical goods has just been completed by the Bureau of Foreign and Domestic Commerce. The findings are published in booklet form now available.

The study covers a house located in the South having an annual sales volume of less than $500,000. It is really a branch of an establishment with headquarters in one of the larger Northern cities, which, in turn, is affiliated with one of the national electrical concerns as distributor.

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Provide High-Intensity, Low-Voltage Products

ANNOUNCEMENT HAS BEEN MADE by Claude Neon Lights, Inc., of the conclusion of agreements with the Electrical Products Corporation of Los Angeles and with the Claude Neon Displays, Inc., of Buffalo, for the manufacture and sale of the new high-intensity, low-voltage neon and other rare gas products. Addition to the manufacturing facilities of the Buffalo factory is practically completed, and a similar addition will be started at once in Los Angeles. In both cities the added facilities will be used to produce complete units for luminous and illumination purposes, developed by the New York, Paris and Vienna branches of the Claude Neon Laboratories. These include a new tube light of extra brilliance for signs, lighting units for stores, shops, show windows, etc. The new product is available at present in three colors—red, blue and green.

For display signs, the new tubes are especially adapted for congested and highly illuminated districts, and for long-range usage. As previously announced, these tubes will operate on standard 110-220-volt electric current, for both a.c. and d.c.

Unemployment Relief for Electrical Construction

PLANS FOR UNEMPLOYMENT RELIEF in the electrical construction industry sponsored by the Electrical Guild have been placed before the National Electric Light Association, the Association of Edison Company Executives and the National Electrical Manufacturers' Association. They are said to have been accepted enthusiastically by labor. A handbook outlining the plan has been prepared by the International Brotherhood of Electrical Workers and may be secured from that organization at 1200 Fifteenth Street, N. W., Washington, D. C.

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Unlocking the Electrical Contractor's Market*

By A. PENN DENTON

THE electrical industry stands today at the crossroads of progress. Temporarily the phenomenal growth of the industry has been halted, with that of other industries, in a business depression more severe and in many respects unlike that of any previous depression in the many-recurring prosperity and depression cycles of American business during a century of industrial development and progress.

The electrical industry may take some pride in the fact that we are better off than other industries in this country, but that can give us but little comfort when the great masses of our people have been so hard hit and there is such widespread business mortality and unemployment.

There are today in this country 20,000,000 wired homes and not 1 per cent of these homes are adequately wired. These homes have become a potential market for all groups of our industry which only the electrical contractor can unlock.

I shall discuss with you only the possibilities of developing the residential wiring market, as I am convinced that in this direction must our industry turn for immediate relief from the present business depression. Now, considering these 20,000,000 wired homes I have referred to, let us assume that there is needed in each home additional outlets, circuits, feeder and service capacity which will cost approximately $50 per home. This makes a total possible business of $1,000,000,000 for wiring alone. Add to this as a conservative figure an additional $100 per home for electric heating and cooking devices, comfort and pleasure-making appliances and radio and you increase your potential market by $2,000,000,000, a total of $3,000,000,000. Let us set as our goal a five-year program in which this large volume of business will be sold, and it gives us an annual business of $600,000,000.

You say this is impossible, impractical and I will agree to cut the quota right in two. We still have the enormous business volume of $300,000,000 per year made available to all groups of our industry through the simple process of the contractors unlocking this great market, which is almost begging us to release it.

You who are qualified and organized contractors are entitled to this $1,000,000,000 or $500,000,000 of wiring in residences which is to be done in the next ten years. It isn't yours for the asking, but it is yours if you are willing as business men to work hard for it. Assuming that through organized effort you build up your local chapter membership to a point where your inter-

*From an address before Association of Electragists, International, Convention, Hot Springs National Park, Arkansas.

national membership totals 5,000 you have available a potential wiring business of $20,000 per year per member in rewiring alone for the next five years, and another $20,000 per year per member in appliance business. This leaves untouched $100,000,000 per year for industry groups other than the electrical contractor.

You must guide the industry, as I see this problem, in doing the following things:

1. Develop adequacy standards for all types of buildings as provided for in the installation layout or emergency design of your Electragist standards for wiring installations.
2. The industry must give sympathetic and intelligent guidance to municipal electric ordinances and state statutes.
3. Establish educational mediums to reach contractors:
   (a) Monthly "How to Sell" bulletins.
   (b) Contacts with local chapters of A.E.I. or organized groups on sales plans.
4. Encourage power companies to initiate locally:
   (a) Added outlets sales campaigns.
   (b) Customer surveys for adequate wiring.
   (c) Financing or rewiring sales.
   (d) Co-operation with local contractors.
5. The industry must provide a plan that will dramatize to the public adequate wiring as essential in making electrical service available.

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TRADE BRIEFS

Belden Manufacturing Company announces the appointment of Russell Koenitzer as representative in the Detroit-Cleveland territory.

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H. W. Burritt, vice-president in charge of sales of the Leonard Refrigerator Company, Grand Rapids, Mich., and also occupying the same executive position for the Kelvinator Sales Corporation, of which Leonard is a division, announces the appointment of R. I. Petrie as sales manager of the Leonard Refrigerator Company, succeeding A. H. Jaeger, resigned.

•

W. N. Matthews Corporation, St. Louis, Mo., paid the 32d consecutive quarterly dividend of $1.75 per share on preferred stock to holders of record June 20, 1931.

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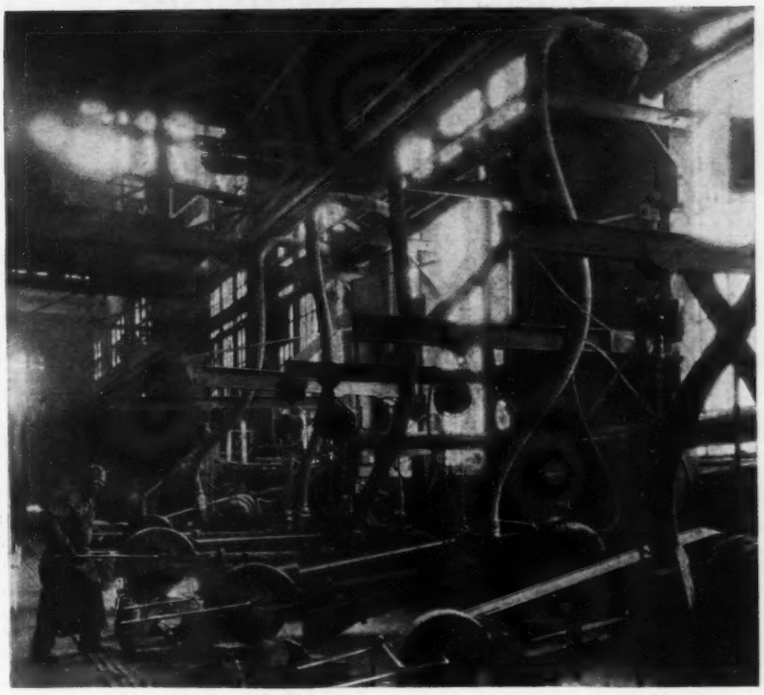
Harland E. Stockwell, New England sales representative of the Jeffery-Dewitt Insulator Company, Schweitzer & Conrad, Inc., and the Davis Transformer Company, has established an office at 161 Devonshire Street, Boston.

VENTILATION OF SWING GRINDERS



Removing fins and spines from steel castings in the Schenectady works of the General Electric Company. The machines are connected to swing ventilators and this flexible exhaust system is applied to the motor-driven grinders by five jib cranes.

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American Manganese Steel Company has appointed W. C. Bruton district sales manager for the Pacific Northwest territory, comprising Oregon, Washington, British Columbia and the Cœur D'Alene district in Idaho.

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Austin D. Smith, president of David H. Smith & Sons, Inc., announces the acquisition of the Water Arc Welding Corporation.

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Otto Nonnenbruch has rejoined the Worthington Pump & Machinery Corporation as special sales representative with headquarters at Buffalo. J. B. Allen has been appointed special marine representative with headquarters at Harrison. H. G. Wood has joined the Worthington corporation as electrical sales engineer. E. M. Paullin has been appointed electrical sales engineer at the Cincinnati, Ohio, works.

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H. L. Robinson has been appointed general sales manager of the Foster Wheeler Corporation.

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More than 37,000 employees of the Westinghouse Electric & Manufacturing Company are protected by approximately $98,000,000 of group life insurance, under which plan about $4,000,000 has been paid to beneficiaries, according to a booklet prepared by the company.

The Riley Stoker Corporation has appointed F. E. Fleming as sales engineer at the Chicago office and R. L. Sauer district manager at Detroit.

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The sales organizations of Keasbey & Mattison Company and the Ambler Asbestos Shingle & Sheathing Company have been combined. All sales are being handled by Keasbey & Mattison Company. Factories and main offices are located at Ambler, Pa.

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Westinghouse Lamp Co. Has New Sales Plan

CERTAIN CHANGES IN the Westinghouse Lamp Company's policies governing the sale of its miniature "Mazda" lamps are announced by A. E. Allen, vice-president. The changes include a revision of trade discounts to dealers and distributor agents. Dealers will be enabled to buy their requirements of lamps at a discount of 40 per cent instead of 35.

The schedule of discounts applying to jobber agents has likewise been revised upward. The whole plan is carefully calculated to bring all prices and terms in close accord with the relative cost of handling each channel of distribution employed to reach the ultimate market.

Market Conditions

NEW ENGLAND notes an increase in electrical orders this week, with small motor sales and appliance business better. Buying continues uneven in the Eastern district, although municipal prospects are much brighter. Government and central station buying is quiet at the moment.

——PACIFIC COAST ORDERS ANTICIPATED for some time are now coming into the market in a larger way. Construction of public buildings is active. Business is quiet, however, in the Seattle area.

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SOUTHEAST

—THERE APPEARS *to have been a very slight improvement in the general tone of business during the past week. Utilities have been buying a little more freely. The dark spot still seems to be in appliances; even where heavily advertised the volume of sales has been considerably below normal.*

Orders worthy of mention which have been placed since last report include a lot of distribution transformers for a Texas power company costing $3,000, an order for meters amounting to $5,000, lightning arresters for a Southwestern company $11,000 and repairs to a large turbo-generator, including reblading, $20,000.

CONSTRUCTION PROJECTS

Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until November 3 for turbine-driven generating units, condensers, air ejectors, etc., and spare parts for Norfolk, Va., and Philadelphia, Pa., navy yards (Schedule 6719); also, until October 27 for a pot type electric furnace for Pensacola, Fla., navy yard (Schedule 6723). Champion Fibre Company, Canton, N. C., has authorized an expansion and improvement program to cost about $1,000,000. Augusta, Ga., plans electrification of former canal system and will install 10,000-kw. Diesel engine-generating plant, transmission lines and power substation.

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SOUTHWEST

—ANOTHER QUIET WEEK *was reported in electrical circles of the Southeast. However, the larger reporting concerns state that the general tone of business seems slightly improved.*

A textile mill in the Carolinas last week placed orders for oil circuit breaker equipment amounting to $26,000 and power transformers totaling $15,500. A power company in Georgia placed orders last week for creosoted pine poles and pole line hardware aggregating $5,060 and arresters and insulators totaling $4,600. A North Carolina company ordered $1,200 worth of distribution transformers. An interesting contract recently let in Atlanta is for a 30x30-ft. spectacular electric sign.

CONSTRUCTION PROJECTS

Contracting Officer, Quartermaster Corps, Fort Riley, Kan., will receive bids until October 28 for electrical supplies (Circular 45). Community Refining Company, Pawhuska, Okla., plans extensions and improvements in oil refinery to cost over $65,000. General Development & Shares Corporation, Enid, Okla., has filed plans for a public market to cost about $125,000. Southern Pacific Railroad Company, Houston, Tex., plans to begin construction of passenger terminal in December, estimated to cost $3,000,000.

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NEW ENGLAND

—AN INCREASE IN ORDERS *for electrical equipment during the past week is noted in this district, with small motor sales gaining and general scheduled equipment for power control steady in small lot deliveries.*

—INQUIRIES ARE INCREASING *gradually as compared with last month and sales for the last quarter appear to be turning into an encouraging trend, according to one prominent manufacturer's representative.*

New construction needs for a vehicular tunnel to be ordered soon include motor-driven ventilating equipment and control to cost about $150,000. Sales service station flooded lighting units are active. An order for 129 reflectors for illumination for the Rhode Island State Capitol was recently recorded. Gradual gains in sales of electric water heaters are reported by one prominent central station and total over 130 for a recent selling campaign. Orders for central-station equipment are spotty and confined to small lot items and heavy equipment interest is centered on buying a number of turbo-generators. Industrial plants in this district report slight upward trend in activities.

CONSTRUCTION PROJECTS

Standard Oil Company of New York, New York City, has plans under way for an oil storage and distributing plant at Quincy, Mass., to cost approximately $1,000,000. Public Buildings Department, Boston, Mass., has authorized plans for a police station to cost $350,000. School committee, Boston, Mass., has approved an appropriation of $920,000 for construction of a girls' high school.

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EASTERN

—ELECTRICAL EQUIPMENT DEMAND *continues its uneven pace in the Eastern district. Buyers with vision realize that the present is an opportune time to purchase to advantage, and a comparison of average current quotations with those of several months ago shows conclusively the reason why. Municipal account is reaching higher levels and good promise is indicated in that quarter for a number of weeks to come.*

—GOVERNMENT CALL SHOWS *temporary easing, but is expected to be resumed promptly to carry out projected federal programs. Central-station business exhibits lagging tendencies, with industrial account showing little intention of entering the market under present trade conditions. Electrical specialties are a bright spot in the situation, with plant schedules stepping up in an encouraging manner.*

The Board of Transportation, New York, furnishes the high light of the week with its award for 500 steel cars for the new subway system, referred to in these columns recently. The General Electric Company has secured the contract for motors and allied apparatus at a price of $2,392,500, while Westinghouse Electric & Manufacturing Company will supply the control apparatus for the 500 car units at $1,300,000. The General Railway Signal Company is the successful bidder for block signaling and interlocking apparatus at a price of $2,317,800. The cars will be built by American Car & Foundry Company, the lowest of five bidders, at a price of $10,531,500. The two last noted companies will arrange immediately for increased plant schedules.

A sizable contract has been secured by Westinghouse Electric & Manufacturing Company for turbine machinery and accessories for three United States battleships, *New Mexico, Idaho* and *Mississippi*, and work will be carried

out at the South Philadelphia plant of the company. Westinghouse transformer orders have resulted in higher production schedules at the Sharon, Pa., works and a large quota of employees have been reinstated; a recent contract for heavy car transformers approximated $1,400,000.

A manufacturer of electric clocks in New England reports sizable advance in demand and is increasing output about 33 per cent, with additions to working force. A maker of electrical testing apparatus at Cleveland is running on a capacity basis and reports sales for the first nine months of 1931 totaling 40 per cent over those for the corresponding period last year. A producer of radio tubes in Brooklyn has secured a contract for 2,000,000 tube units from a Middle West distributor and will advance production at once.

CONSTRUCTION PROJECTS

Signal Supply Officer, Signal Corps, United States Army, Army Base, Brooklyn, N. Y., will receive bids until November 6 for equipment for modification of 1,700 mast sections (Circular 38). State Board of Education, Trenton, N. J., has approved fund of $411,000 for new buildings at State Manual Training and Industrial School for Colored Youth, Bordentown, N. J. Board of Education, Philadelphia, Pa., plans multi-story junior high school to cost over $600,000. Treasury Department, Washington, D. C., will soon take bids for marine hospital at Baltimore, Md., to cost $1,000,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until October 27 for eight motor-generator sets and sixteen sets of spare brushes for Washington yard (Schedule 6732); until October 27 for one heat-treating electric furnace for Washington yard (Schedule 6698), and until October 27 for two motor-generator sets for naval air station, Lakehurst, N. J. (Schedule 6730).

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MIDDLE WEST

—GENERAL BUSINESS *in the Middle West section again appears to be marking time. While the volume of business is holding up fairly well, the general trend is considerably mixed. The optimistic spirit, noticeable at the beginning of the quarter, still prevails, although not enough favorable indications are being observed to maintain this sentiment for any great length of time.*

The stimulation to general confidence looked for from the Hoover financial plan has failed to materialize, due, perhaps, to a slowness in getting started. The major activities are in relatively the same position with nothing startling in sight. Wholesale and retail trade continues to hold up fairly well with a considerable amount of seasonal buying going on. The various utility companies are particularly quiet, although there is a considerable amount of apparatus on inquiry and a number of large construction jobs in view. There has been a slight increase in the demand for distribution materials this week.

CONSTRUCTION PROJECTS

Grand Trunk Western Railway Company, Muskegon, Mich., plans installation of electric power equipment in connection with commercial dock on Lake Muskegon, to cost $250,000. United States Engineer Office, Chicago, Ill., will receive bids until October 30 for three control stations at locks on Illinois River (Circular 5). Midland Steel Products Company, Cleveland, Ohio, will carry out expansion program at plant to cost over $100,000. Standard Oil Company of Ohio, Cleveland, Ohio, contemplates expansion and improvements in recently acquired oil refinery at Lima, Ohio, to cost over $150,000. State Commissioner of Administration and Finance, St. Paul, Minn., will soon take bids for a multi-story state office building to cost $1,000,000.

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PACIFIC COAST

—CURRENT BUSINESS *is reflecting various large building jobs which figured in the reports several months ago, but which are now in the ordering stage, such as the war memorial building in San Francisco.*

—MANY MAJOR BUILDING ITEMS *are reported, including a gymnasium for the University of California, the Berkeley post office, a half-million-dollar hangar and flying field equipment for Honolulu, with a large lighting proportion.*

Orders also include the $500,000 storage warehouse for the Harbor Commission in San Francisco, approximately $2,000,000 of state and county hospitals in the central California area, and especially the $12,000,000 Los Angeles union depot, for which plans will be approved this year, the station proper costing $2,000,000, and a large proportion of the balance of covering special cabling and lighting of terminal yards. Orders include a $14,500 fixture contract for the deaf school in Berkeley, a $100,000 substation for Vallejo, $10,000 for two 2,000-amp., 15,000-volt, 750-kva. circuit breakers for Los Angeles and a $24,000 award for 66 standards with cables and wire for San Jose street-lighting system. Other machinery orders include $19,000 worth of Westinghouse transformers for San Francisco area, an $11,000 generator and exciter equipment for Utah, a $12,000 motor for Boulder Dam, one carload of Westinghouse refrigerators for a San Francisco jobber, a $60,000 elevator equipment for Portland and General Electric replacement parts for a paper factory. Prices are steadier, though dropping a little because of raw material increases.

Movement of heavy apparatus, wire, poles and pole line hardware and scheduled material is reported practically nil, with no early signs of improvement. Range sales are from fair to good, midget radios are moving fairly well and lamp sales are holding up, although activity is far below normal. Both dealer and jobber stocks are low. Motor sales continue extremely light, although a number of inquiries have been received recently from paper and lumber mills in the Puget Sound area and from mines in the Cœur d'Alene, Idaho, district and Alaska. Motor sales reported last week include 30 machines from 50 hp. down to lumber mills for replacements, allied woodworking industrials and miscellaneous sources, 24 ranging from 25 hp. down to dealers and pulp mills, ten from 15 hp. down to mills and mines and 20 from 50 hp. down to dealers and industrials. One jobber reported the sale of fifteen transformers from 1½ to 15 kva. Orders for approximately $51,000 worth of hydraulic apparatus for Prosser, Wash., power plant and Kennewick Highlands pumping plant, Yakima project, were placed in Washington, D. C., with General Electric, Graybar, Pennsylvania Transformer Company, Bowie Switch Company and Worthington Pump & Machinery Corporation. Seattle City Light Department opened bids for 50,000 lb. of No. 4 triple-braid, weatherproof, soft-drawn solid copper wire and Snohomish, Wash., is considering immediate installation of a new street-lighting system covering the business district.

CONSTRUCTION PROJECTS

San Joaquin Light & Power Corporation, Fresno, Calif., is having plans completed for a 50,000-kw. steam-operated electric power plant to cost over $1,500,000, with transmission lines. Fields Chemical Corporation, Long Beach, Calif., has plans under way for plant to cost close to $100,000. Tacoma, Wash., plans extensions and improvements in street-lighting system, including new power substation, entire program to cost $500,000. United Collieries of Washington, Inc., Seattle, Wash., plans the installation of electrical and mechanical equipment at its coal properties near Glacier, Wash., to cost over $100,000.

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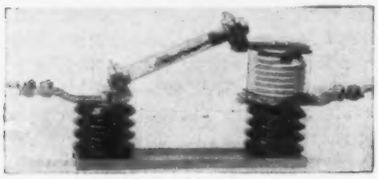
Metal Prices Show Greater Stability

	Oct. 14, 1931 Cents per Pound	Oct. 21, 1931 Cents per Pound
Copper, electrolytic	7	7
Lead, Am. S. & R. price	4	3.75
Antimony	6.50	6.50
Nickel, ingot	35	35
Zinc, spots	3.75	3.65
Tin, Straits	23.35	23
Aluminum, 99 per cent.	23.30	23.30

New Equipment Available

Potential-Transformer Circuit Fuse

A DEVICE FOR INSTALLATION in potential-transformer circuits, known as type CM-45 RR, has been announced by Schweitzer & Conrad, Inc., Chicago. This device consists of a current-limiting resistor inclosed in a Pyrex glass housing which is dust-proof, mounted in



series with a low-current fuse having operating characteristics that will protect the potential transformer in case of primary or secondary faults. The time-current characteristics of the fuse are permanently accurate, it is claimed, and with the use of this equipment the short-circuit current that might be released without a resistor is reduced to a very low value and therefore does not subject the system to a severe shock in case of short circuit. The equipment can be made for either indoor or outdoor service.

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Unit Type Collector Rail Supports

A LINE OF UNIT TYPE collector rail supports has been announced by the Delta-Star Electric Company. The insulator units are standard indoor wet process porcelain with center bolt construction requiring one mounting bolt and providing for any angle adjustment of the fittings. They are designed to allow for expansion and contraction of the rails without binding. The clamps are adjustable and several sizes of rails can be used with each.

In addition to high mechanical and electrical strength, this construction has the advantage that, in the event of breakage, the insulators can be replaced without scrapping the entire support.

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AN ALLOY OF COPPER, NICKEL, ALUMINUM AND ZINC, know as "Alcunic," has been announced by the Scoville Manufacturing Company, Waterbury, Conn. It has unusual physical properties at both ordinary and elevated temperatures and a very high resistance to general corrosion. This combination of properties, together with its resistance to air impingement, makes it an ideal condenser-tube metal. The approximate composition of "Alcunic" is 80 per cent copper, 2 per cent aluminum, 1 per cent nickel and 17 per cent zinc.

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AN IMPROVED TYPE OF TREE WIRE and aërial cable, bringing cutting of foliage in residential districts to the minimum, has been announced by the General Electric Company. Advantages of the new cable include the ease with which splices and joints can be made and the improved wearing qualities of the insulation. The new tree wire is in sizes No. 10 to No. 2 AWG and is available for 600-, 2,500-, 3,500-, 5,000- and 7,500-volt service.

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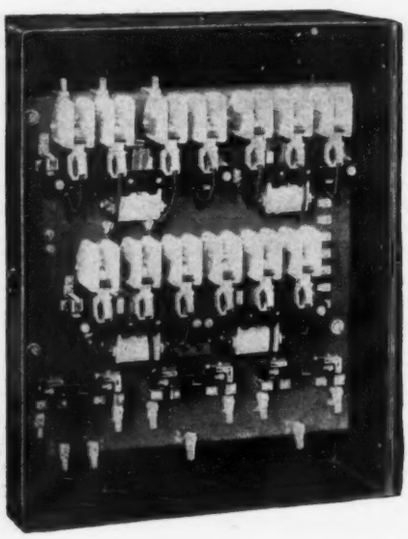
Across-the-Line Switches for Multi-speed Motors

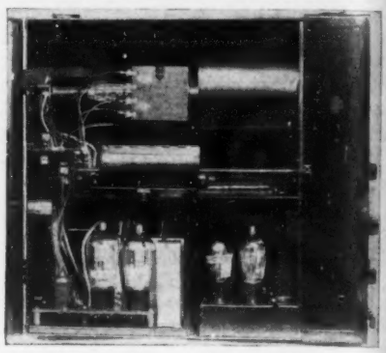
A LINE OF MULTI-SPEED across-the-line switches has been announced by the Allen-Bradley Company, Milwaukee. These switches are for two-, three-, or four-speed, non-reversing service, in connection with two-phase and three-phase multi-speed motors of consequent-pole-winding or separate-winding type, in ratings up to 40 hp., 220 volts, and 75 hp., 440-550 volts, 25 to 60 cycles.



Complete protection against overloads is provided through the use of thermal overload relays for each speed. No-voltage protection is a standard feature with three-wire control and no-voltage release with two-wire control.

Cathode-Ray Oscilloscope

ORIGINALLY DEVELOPED for television, the latest Westinghouse cathode-ray oscilloscope places in the hands of engineers, it is claimed, a portable high-speed instrument, free from moving parts and especially suitable for visualizing periodic electrical phenomena. It easily catches movements lasting but a millionth of a second. The curve traced on the oscilloscope's screen is brilliant enough to be seen in daylight,



making the device of considerable importance in lecture rooms for demonstrating such difficult problems as the effect of circuits on wave form. A special multi-vibrator circuit gives linear timing when wanted, but this instrument, unlike the ordinary oscillograph, is not tied down to "time" as abscissa, but plots any two variables against each other.

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Porcelain Guy Insulator

PORCELAIN GUY INSULATORS as a substitute for the wooden insulators now extensively in use on wooden-pole lines have been announced by the Locke Insulator Corporation, Baltimore. These insulators have ample mechanical strength, show no deterioration in either surface or strength, are not easily broken and have electrical characteristics equal to wooden insulators of at least tiwce the length, the maker states.

Since no arcing horns are required, the line presents a considerably better appearance and does not interfere with secondary circuits on the same poles as is the case with the horns on wooden insulators, it is claimed. These insulators are easily coupled in series where greater flashover values are desirable.

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AN IMPROVED SMALL PORTABLE SPRAY-PAINTING OUTFIT, known as NC-697, has been announced by the DeVilbiss Company, Toledo, Ohio. It is electrically driven and operates economically on any light socket. The compressor and motor are compactly and securely mounted on a rubber-footed metal base.